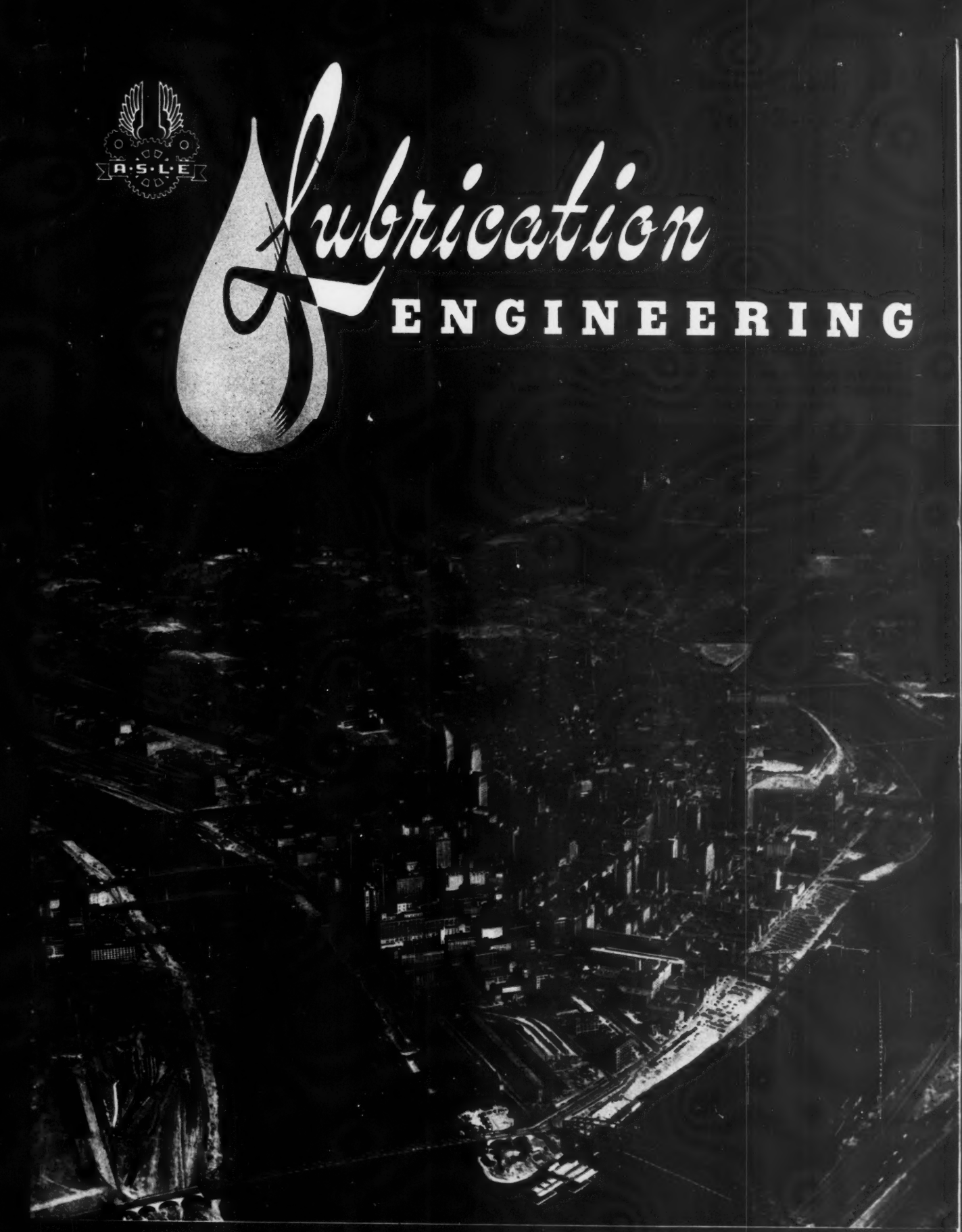
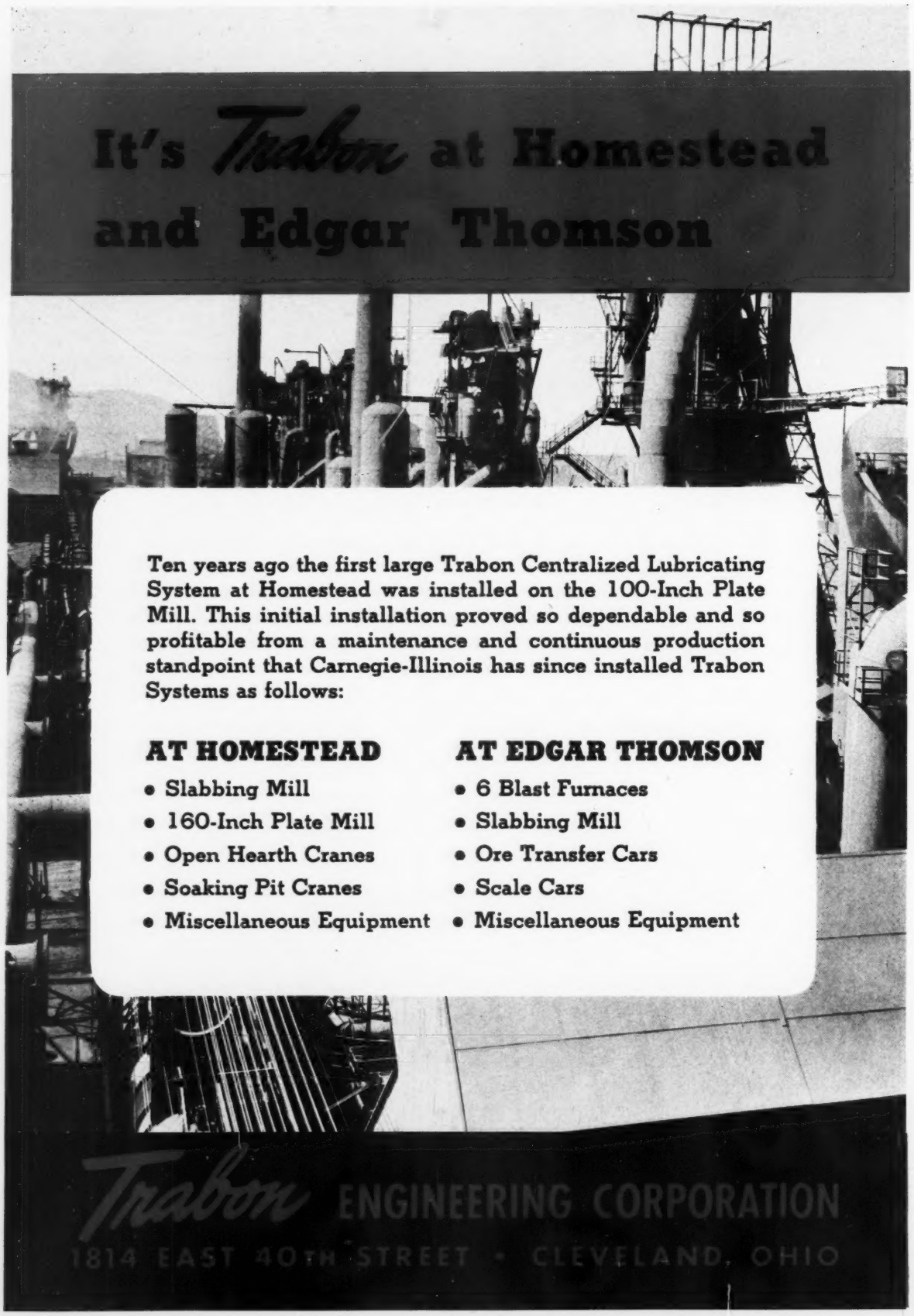
Lubrication ENGINEERING

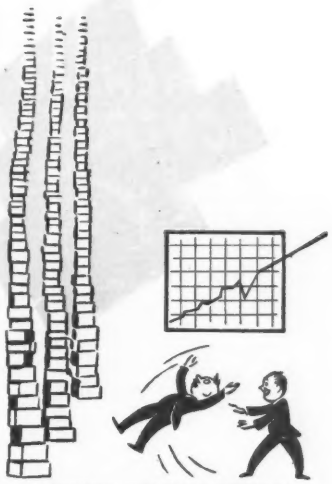


JOURNAL OF THE AMERICAN SOCIETY OF LUBRICATION ENGINEERS

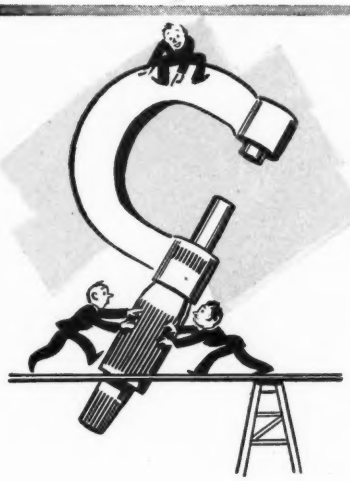

It's Trabon at Homestead and Edgar Thomson
Ten years ago the first large Trabon Centralized Lubricating System at Homestead was installed on the 100-Inch Plate Mill. This initial installation proved so dependable and so profitable from a maintenance and continuous production standpoint that Carnegie-Illinois has since installed Trabon Systems as follows:
AT HOMESTEAD
• Slabbing Mill
• 160-Inch Plate Mill
• Open Hearth Cranes
• Soaking Pit Cranes
• Miscellaneous Equipment
AT EDGAR THOMSON
• 6 Blast Furnaces
• Slabbing Mill
• Ore Transfer Cars
• Scale Cars
• Miscellaneous Equipment
Trabon ENGINEERING CORPORATION
1814 EAST 40TH STREET • CLEVELAND, OHIO

WHY IT PAYS TO USE THE *RIGHT* CUTTING OIL

LONGER TOOL LIFE



HIGHER PRODUCTION



CLOSER TOLERANCE

BETTER FINISH

BETTER CHIP SEPARATION

SHELL HAS THE *RIGHT* CUTTING OIL FOR EVERY APPLICATION

SHELL KNOWS THE IMPORTANCE of using the right oil for a particular cutting job. That is why Shell Lubrication Engineers balance the oil to fit the machine . . . the application . . . and the tool.

Make sure the machines in your plant get the benefit of all that's new in lubrication. Call the Shell Lubrication Engineer. Shell Oil Company, Incorporated, 50 West 50th Street, New York 20, New York; or 100 Bush Street, San Francisco 6, California.

SHELL

SHELL CUTTING OILS

FOR METAL CUTTING AND GRINDING

ThredKut *
INCREASED OUTPUT 4 to 1

... reports
JOHN L. MOROSINI
D. A. Stuart Oil Co.
Representative

"Prior to using THREDKUT,* this customer had tried several types of cutting oil in tapping 1½" dia. x 1" holes in very tough cast steel, with a maximum production of 50 tapped holes before sharpening was necessary. On switching to THREDKUT,* output immediately increased to 200 tapped holes between sharpenings. Here is another instance where THREDKUT* demonstrated its well-established reputation for licking a tough job."

John L. Morosini

ThredKut *

... Stuart's THREDKUT is a unique cutting oil carefully manufactured to insure the maximum benefits from controlled chemical activity. Its outstanding performance on really tough jobs has long been recognized and its flexibility proved through exceedingly widespread use. The many time-tested values built into THREDKUT are serving the leaders of the metal-working industry, increasing efficiency and reducing costs.

Ask to have a Stuart Service Engineer discuss your cutting fluid requirements. THREDKUT literature available on request.

STUART *service goes with every barrel*

WRITE FOR DETAILS

D.A. Stuart Oil co.

2727-31 SOUTH TROY STREET, CHICAGO 23, ILL.

Lubrication ENGINEERING

VOL. 3 DECEMBER, 1947 NO. 4

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LUBRICATION ENGINEERING
Official Publication of the American Society of Lubrication Engineers
343 SOUTH DEARBORN ST., CHICAGO 4, ILL.

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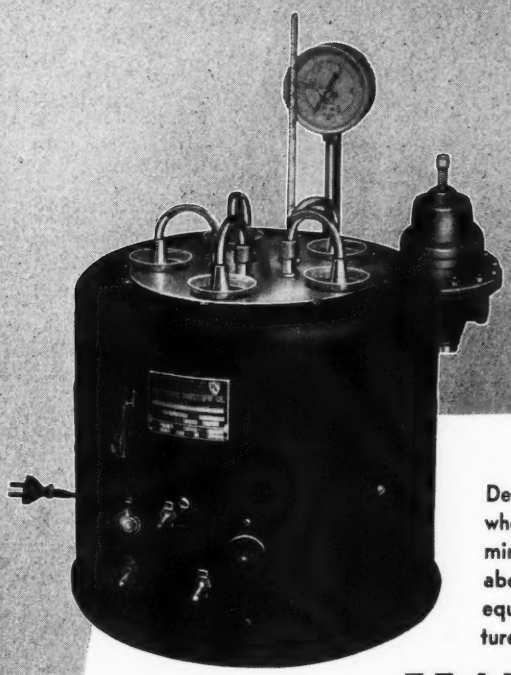
New "PRECISION" 5-UNIT GUM IN GASOLINE APPARATUS



AIR JET METHOD

USING ALUMINUM BLOCK BATH

A. S. T. M. - D-381

Developed to eliminate the difficulties encountered when using an Ethylene Glycol Bath for Gum Determinations, the "Precision" Gum in Gasoline unit shown above represents a major improvement over existing equipment. Tests show that air flow and temperature uniformity are well within A.S.T.M. requirements.

FEATURES

The aluminum block contains five equally spaced holes 2-1/16" diameter, 2-3/4" deep, accommodating five 100 cc lipless Berzelius type beakers. Center of the block forms integral air distribution chamber to insure uniformity to all five air nozzles. A long continuous air pre-heating spiral is cast inside block and stainless steel sheathed electric heating units are clamped to the block bottom. Temperature is easily maintained at normal operating levels well within A.S.T.M. requirements. Temperature of block which determines temperature of beakers and air jets is automatically controlled by adjustable hydraulic thermostat. Heavy glass wool insulation between block and outer sheet metal casing reduces heat loss to absolute minimum. Neon pilot light indicates thermostat operation, and line switch and auxiliary switches control the heating elements. Dial type air flow gauge eliminates need for orifices or capillaries.

Write for literature No. T-10172-G.

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Precision Scientific Company

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Scientific Research and Production Control Equipment

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1 REAL CONDITIONING begins with the water-repellent surface which stops most moisture. Within the element, residue moisture is absorbed; corrosive acids are *neutralized;* gums, resins and varnishes are removed.

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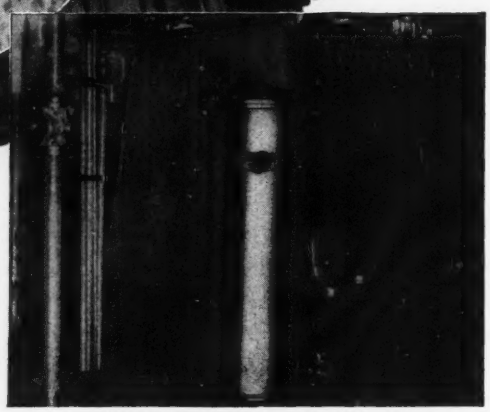
3 FULL-FLOW oil conditioning, pioneered and perfected by Winslow, allows only *conditioned* oil to reach wearing surfaces, brings oil into more frequent contact with elements for quicker removal of impurities. Fill out and mail the coupon today for details.

You incur no obligation by asking Winslow engineers to make recommendations on any problem of filtering liquids of any nature.



● Model 14-1645 Winslow Oil Conditioner, operating in the full-flow lubricating system of a 400HP Busch-Sulzer Diesel Engine.

Winslow makes over 100 complete units and over 200 different sizes and types of replacement elements.

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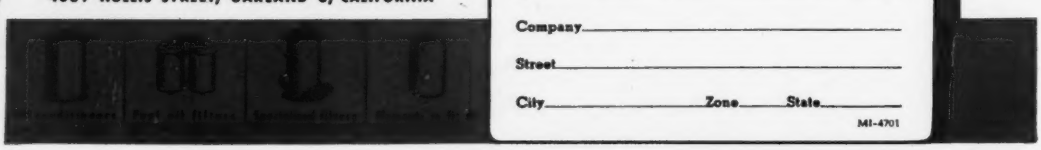

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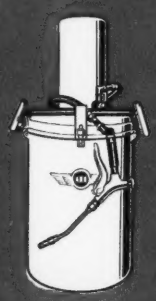
Save time with ARO lube equipment

Model 78 Visi-Flusher

Model 2800 Air Operated Grease Gun

Electric Lubricator Model 2534

Model 2647 Heavy Duty Grease Gun with Filler



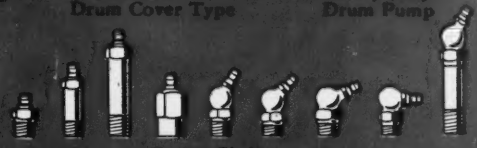
Model 2160 Air Powered Lubricator

Model 2130 Bucket Type Lubricator

Model 2691 Transfer Pump

Portable Model 51-S Drum Cover Type

Model 220 Heavy Duty Drum Pump



Grease Fittings

In today's heavy production, lubrication is tremendously important. Aro's expertly engineered complete line of lubricating equipment has been designed to increase efficiency with less maintenance time and expense. A few of the items in the Aro line are shown here.

Send for details of Aro's complete line

LUBE EQUIPMENT AND AIR TOOLS FOR INDUSTRY... AUTOMOTIVE... FARM

ARO

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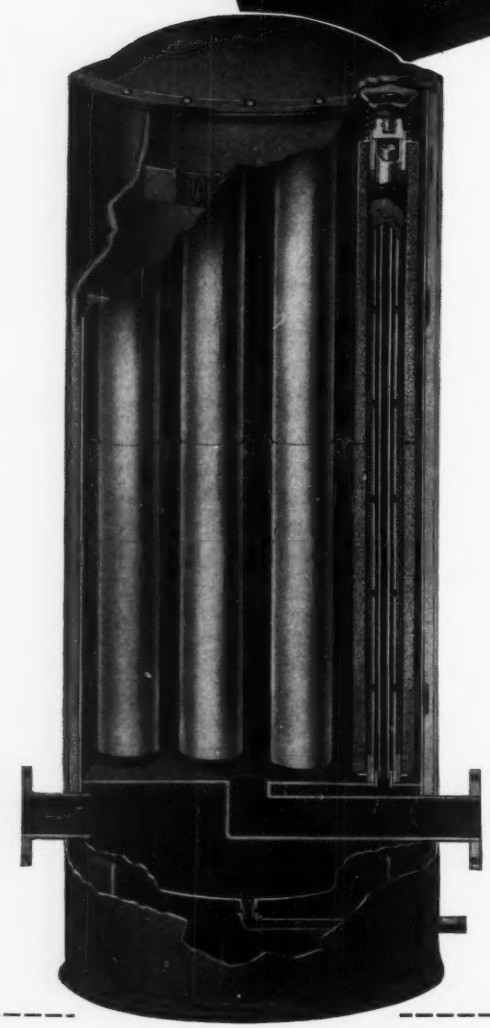
MAYBE IT'S HONAN-CRANE OIL PURIFICATION YOU NEED—



. . . there IS a Difference!

HONAN-CRANE Oil Purifiers give you that "extra" degree of purification not attained with ordinary filters or centrifuges. Purification versus filtration spells the difference in results that points the way to superior engine efficiency and rock-bottom maintenance costs.

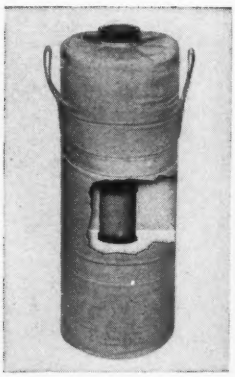
In every case where oil purification has been chosen on the basis of performance under actual operating tests, HONAN-CRANE Oil Purifiers have proved superior—in degree of purification—and in economy of operation.

Why superior? . . . Because HONAN-CRANE Oil Purifiers are performance-engineered from a full knowledge of the problems posed by the many types of engines and equipment using fuel and lubricating oils.

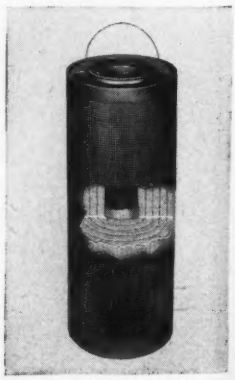
Therefore, to maintain your oils in the best possible condition, you need oil purification equipment engineered to your specific job. You need equipment which is economical to operate, compact in form and simple to install. In short—you need HONAN-CRANE.

May we send you full details on HONAN-CRANE Oil Purification equipment, engineering bulletins and case histories on typical installations? Fill out and mail the coupon.

For Straight Mineral Oils and diesel fuel oils, Honan-Crane Purifiers employ Cranite (specially processed fullers earth) as a purifying medium. The adsorbent material not only removes all abrasives and solids—but goes further to inhibit the auto-oxidation of oil by removal of acids, resins, asphaltines and metallic soaps. These oxidation products form sludges, varnishes, gums, and lacquers which impede lubrication, reduce engine efficiency and hasten wear on bearings, rings and cylinder walls.



For Detergent Oils, Honan-Crane Purifiers are furnished with cellulose fibre cartridges (inter-changeable with the standard Cranite cartridges) hydraulically packed to insure uniform density. Special cellulose fibres are blended by a garnetting process—producing a homogenous filtering maze which insures maximum sediment capacity (longer refill life) and more efficient filtering. The special fibrous medium readily removes particles on the order of a few microns (1 micron equals .000039").



HONAN-CRANE CORPORATION

818 WABASH AVENUE, LEBANON, INDIANA

☐ Please send complete information on HONAN-CRANE Purification of Diesel oils ☐ Please have Sales Engineer call

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A SUBSIDIARY OF HOUDAILLE-HERSHEY CORPORATION

SMOOTH AND CONTINUOUS OPERATION HINGES ON THE *Lubrication System*

MADISON-KIPP ___ is the most dependable lubrication system ever developed. It is applied as original equipment on America's *finest* machine tools, work engines, and compressors . . . You will definitely increase your production potential for years to come by specifying Madison-Kipp on all new machines you buy where oil under pressure fed drop by drop can be installed.

MADISON-KIPP CORPORATION

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WM. COULTHARD & CO. Ltd., Carlisle, England, sole agents for England, most European countries, India, Australia, and New Zealand.

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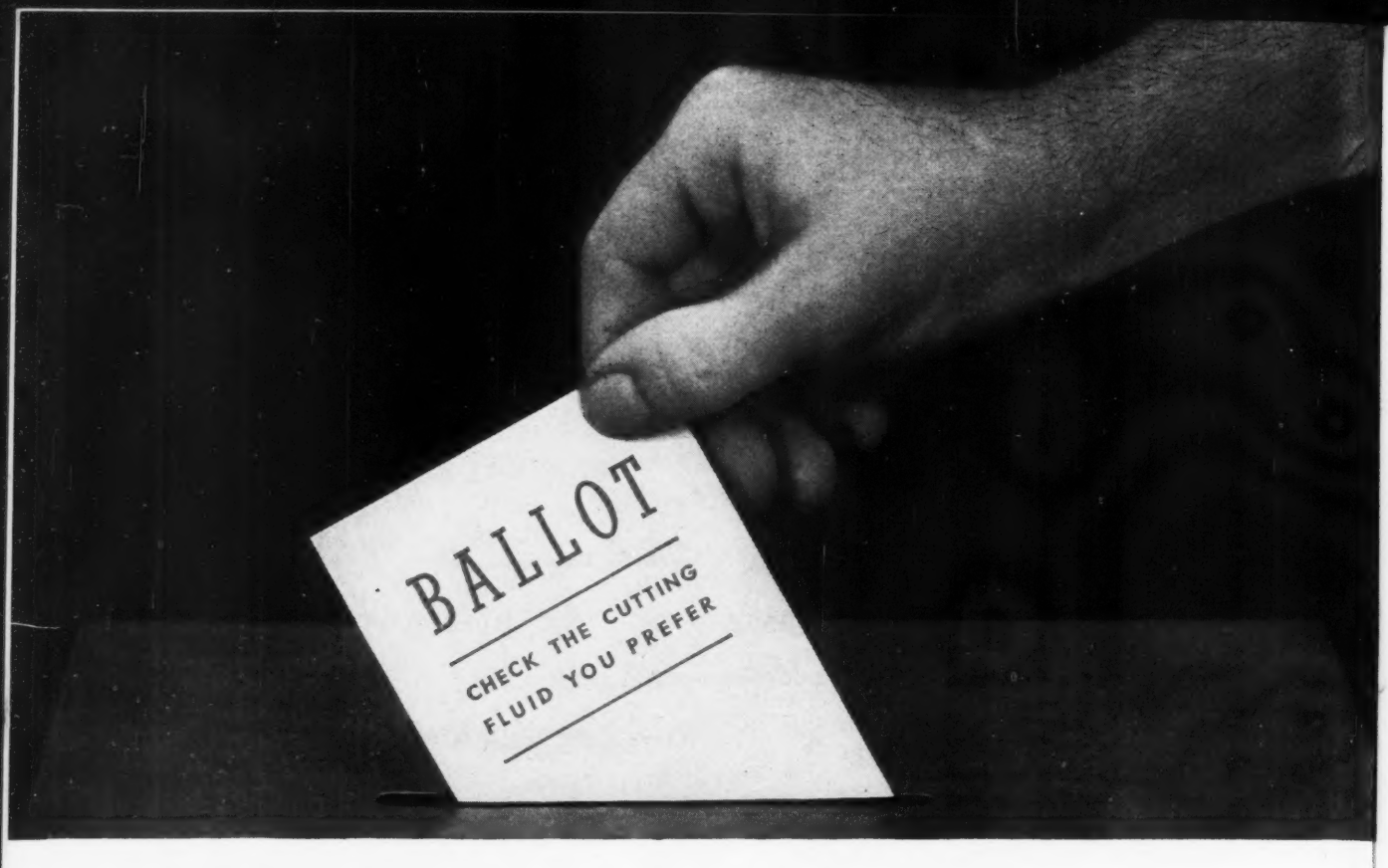
- *Experienced in* LUBRICATION *Engineering*
- *Originators of Really High Speed* AIR TOOLS



THE RESULT'S "IN THE BAG"

when operators vote!

X Yes, Cimcool wins hands down with metal cutting operators. And no wonder! Just look at the platform it runs on (and lives up to).

1 It's clean—doesn't soil hands or clothes.

2 Can't smoke—causes no harmful vapors.

3 Produces no objectionable odors.

4 No slippery film on hands, machine, floor.

5 No chromates or other skin irritants.

6 Is not subject to rancidity.

7 Tools and chips actually stay cool to touch.

OTHER CIMCOOL ADVANTAGES

- Cimcool cools faster—allows faster cutting.
- Uniform work temperature increases accuracy.
- No fire hazard—Cimcool can't burn.
- Contains long-lasting rust inhibitor.
- Chemical lubricity increases tool life.
- Covers 85% of all metal working jobs.

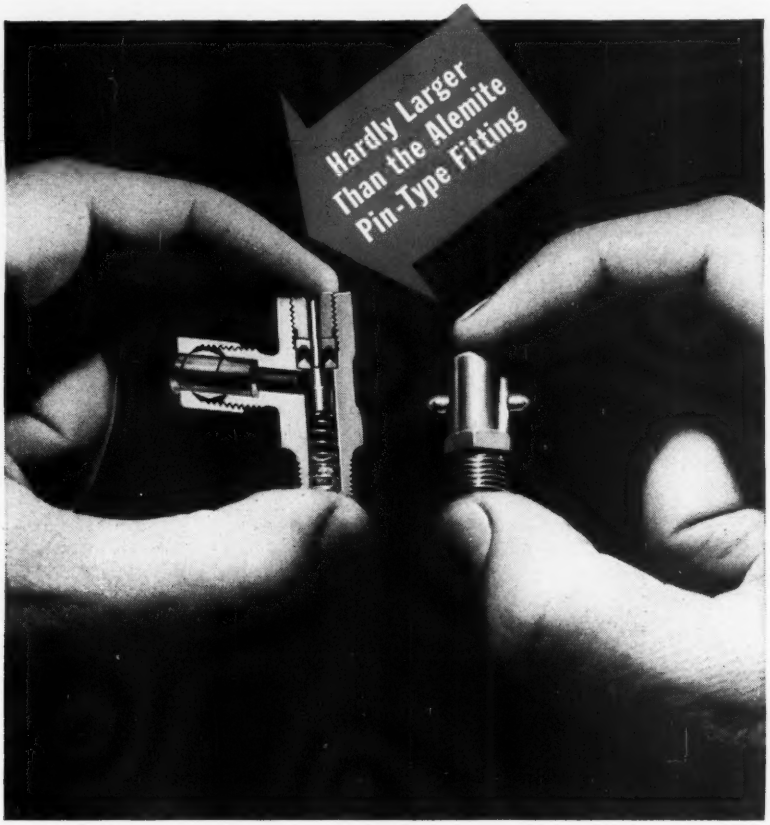
CIMCOOL

THE MULTI-PURPOSE CUTTING FLUID

CIMCOOL DIVISION of THE CINCINNATI MILLING MACHINE CO., CINCINNATI 9, OHIO, U. S. A.

Another Alemite "Cost-Cutter"...

NEW ALEMITE "MIDGET" LUBRICANT MEASURING VALVE

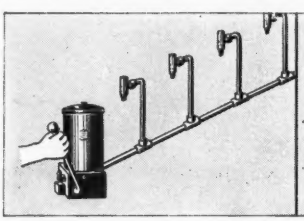


Now You Can Apply Low-Cost Centralized Lubrication to Any Machine

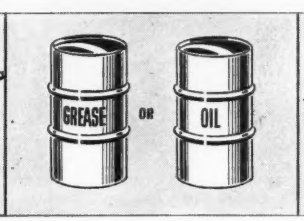
SMALL, SIMPLE, COMPACT . . . this new Alemite "Midget" measuring valve is less than 1½ inches long. In fact, it is not much larger than the popular Alemite fitting used on thousands of machines in every type of industry.

The small sizes of the "Midget," and its simple design, make it suitable for application to all types of heavy, light and precision machines—especially where space limitations are encountered.

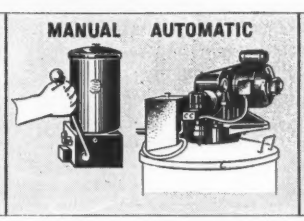
ASK FOR ANY TECHNICAL HELP. Alemite Lubrication Specialists will gladly work with you on any lubrication problems. Their training and experience enable them to render valuable on-the-spot assistance. For an interesting conference and demonstration, write to Alemite, 1847 Diversey Parkway, Chicago 14, Ill.



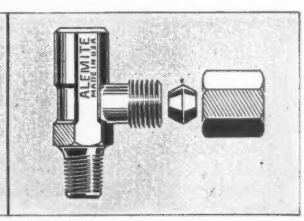
Low Cost, Single Line System. The valves can be mounted on or near bearings, to deliver a measured amount of lubricant from one central point while the machine is producing. No shutdowns, no bearing failures.



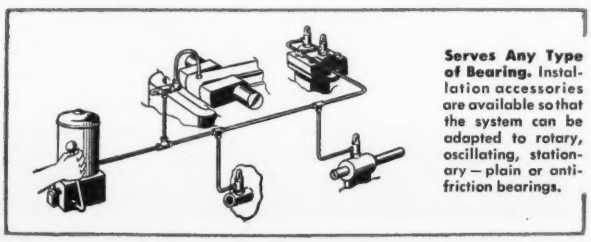
Handles Oil or Grease. There is no danger of over-lubrication or under-lubrication. An indicator signals when the lubrication is completed — eliminating human error. Production goes up . . . costs go down.



Manual or Automatic Operation. A hand pump may be installed in a safe, convenient place on the machine. Or, an Alemite air or electrically operated control will handle a group of machines automatically.



Built-In Compression Fitting is an integral part of the valve and included at no extra cost. No additional fitting is needed to connect tubing to the valve. This is an exclusive Alemite feature.



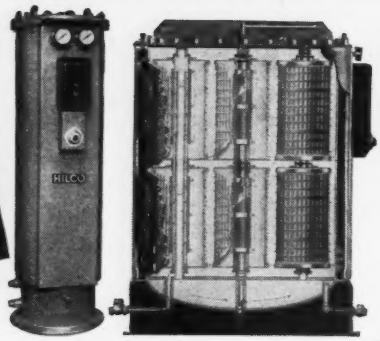
Serves Any Type of Bearing. Installation accessories are available so that the system can be adapted to rotary, oscillating, stationary — plain or anti-friction bearings.

ALEMITE
REG U S PAT OFF
Modern Lubrication that Cuts Production Costs

Another Product of STEWART WARNER

There's a HILCO that will best fit into your Lubricating and Fuel Oil Filtering Plans . . .

HILCO HYFLOW OIL FILTERS "S" SERIES

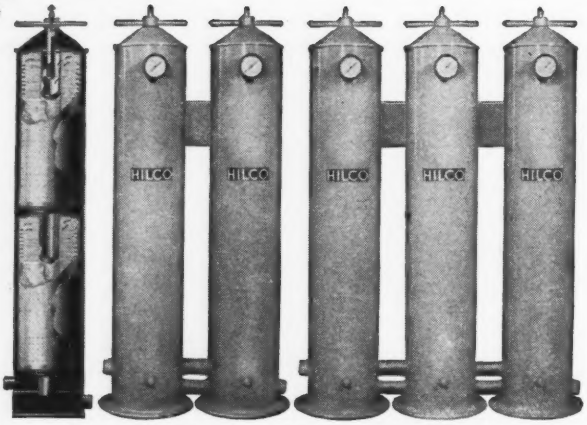


- For lube oil using one or a multiple of 11" x 18" Filter cartridges easily handled by the operator, offering large filter area and proper depth to assure complete saturation of filter material. Available with and without heaters.

**Both are interchangeable at any time.*

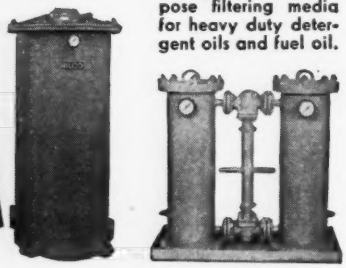
HILCO HYFLOW OIL FILTERS "R" SERIES SPACE SAVERS

- For lubricating oil or storage to engine fuel oil filtering using 5" x 11" and 7¼" x 18" Filter elements. Easy and quick to service.



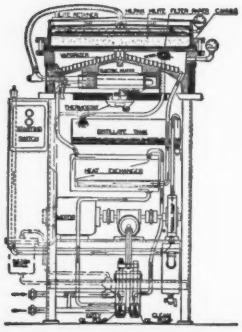
- Hilco Hyflow Oil Filters use Hilite-Fuller's Earth for filtering straight mineral and fuel oil or Hiltex-Cellulose, the all-purpose filtering media for heavy duty detergent oils and fuel oil.

HILCO HYFLOW OIL FILTERS "C" SERIES



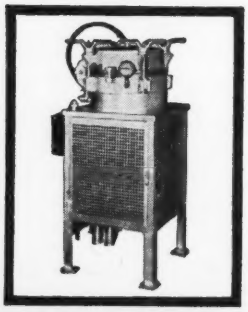
- For Lube and Bulk Fuel using one or a multiple of 7¼" x 18" Filter cartridges offering the maximum in filter area and correct depth for high flow rates and efficient filtration. Available in simplex type with or without heaters, duplex without heaters.

HILCO OIL RECLAIMERS



- For direct connecting to one or more engines for perfect and complete lube oil purification—removing carbon sludge, abrasives, tarry matter, and acids, water and fuel dilution—and color restoration.

Hilite-Fuller's Earth for filtering straight mineral oils—ADSTAY DISCS for heavy duty detergent oils.

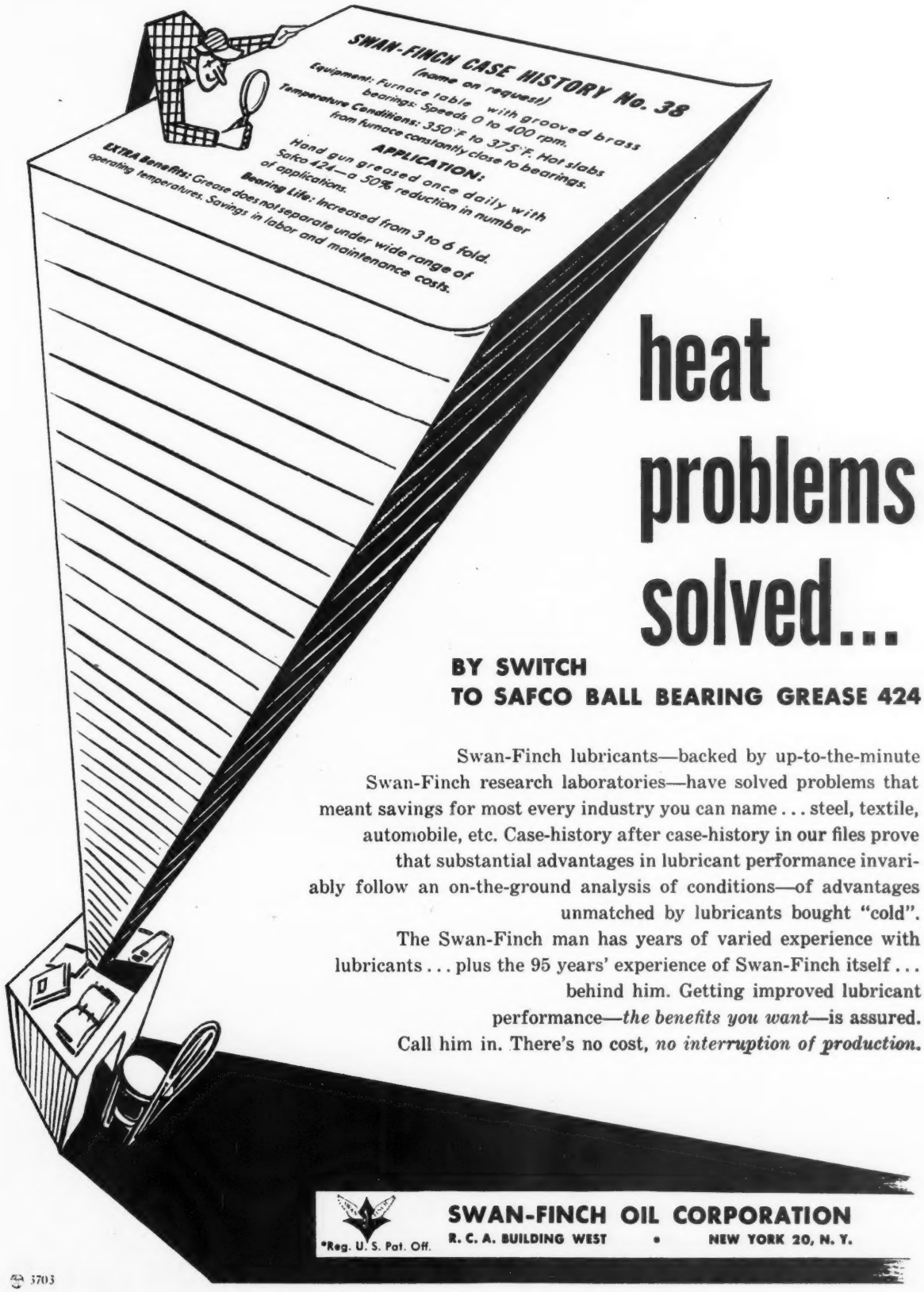


CLEAN OIL MEANS CLEAN ENGINES LOWER MAINTENANCE COSTS . . . .

WRITE TO-DAY! **FOR FREE LITERATURE**

LET US RECOMMEND THE CORRECT OIL PURIFICATION EQUIPMENT

THE HILLIARD CORPORATION 20 W. FOURTH ST., ELMIRA, N. Y.


SWAN-FINCH CASE HISTORY No. 38
(name on request)
Equipment: Furnace table with grooved brass bearings: Speeds 0 to 400 rpm.
Temperature Conditions: 350°F. to 375°F. Hot slabs from furnace constantly close to bearings.
APPLICATION:
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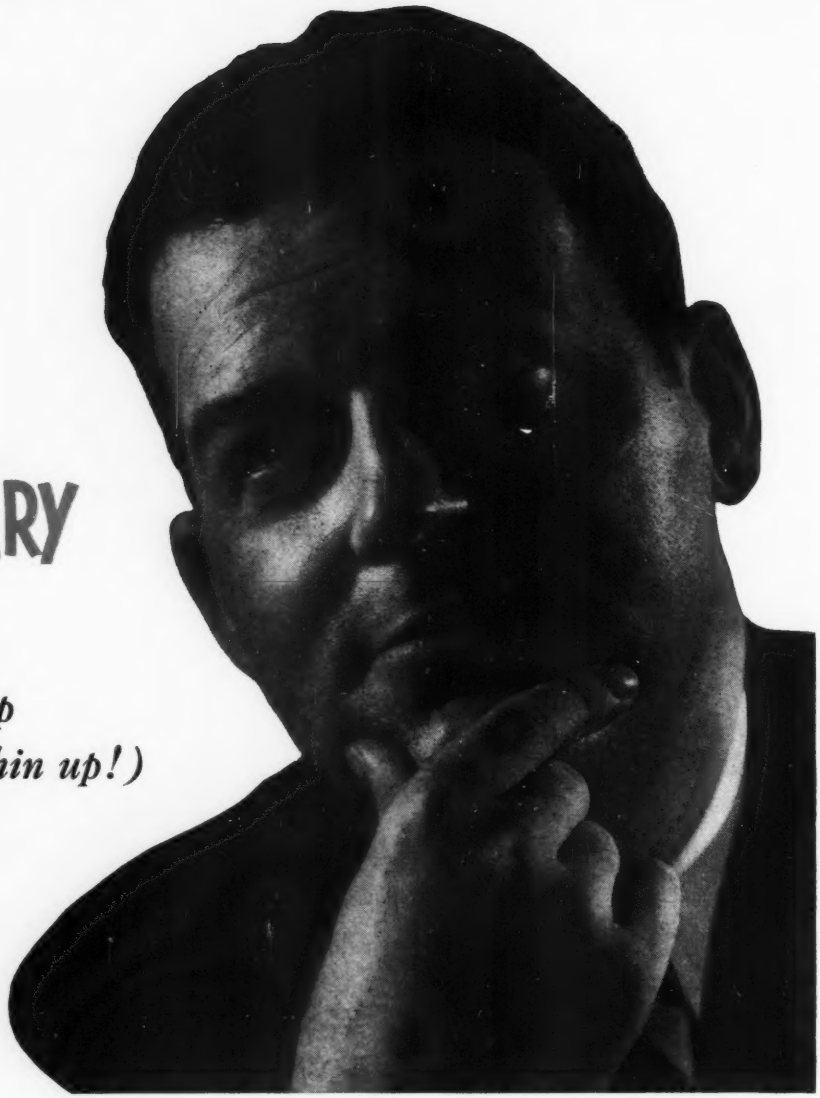

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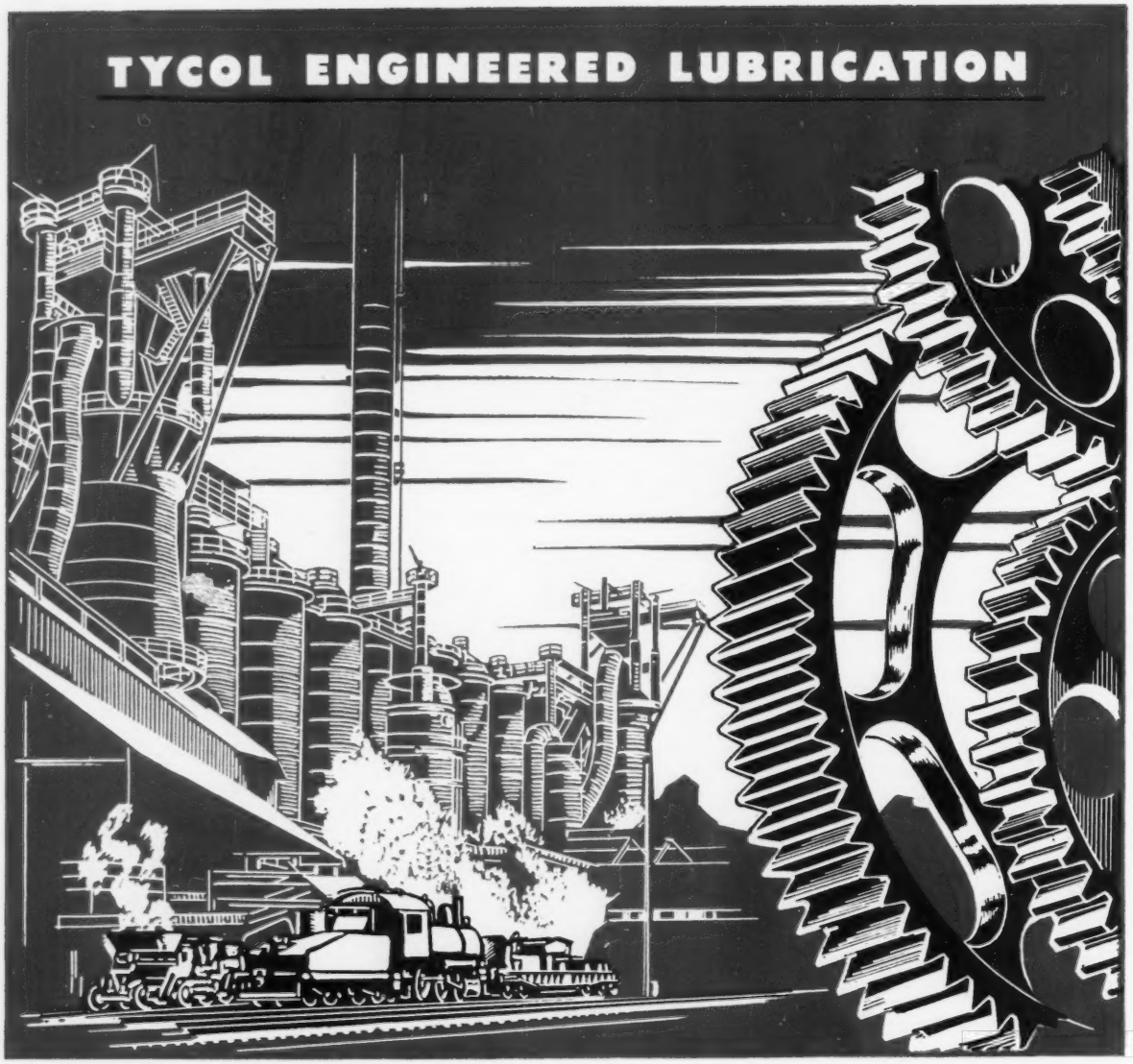

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LUBRICATION—"ENGINEERED TO FIT THE JOB"

THE EDITOR'S PAGE

EDITORIAL

PETROLEUM has long been one of America's most valuable heritages. We have just passed through a costly War, in which petroleum served to the limit. With the return of Peace, it was expected that the consumption of oil products would decrease. Instead, present demand is higher even than wartime demand. It behooves us to consider where we stand and what lies in the future for petroleum.

Not long ago, the American Petroleum Institute assembled some interesting statistics, a few of which are repeated here. Other groups as well are also looking into this problem. In 1947 it is estimated that the equivalent of five hundred seventy-four (574) gallons of petroleum products were used for every inhabitant of the U.S.A., which is 24 per cent over the per capita consumption of 1941. In spite of the apparent lack of new cars (a peculiar viewpoint of those people who do not have one), more than thirty-seven million (37,000,000) passenger cars and cabs were registered in 1947—an increase of some seven million (7,000,000) registrations over 1946. More than two and one-quarter million (2,250,000) barrels of gasoline are used every day by automobiles, trucks, and airplanes.

Home heating with fuel oil and that used by Diesel engines consumes 850,000 barrels of oil per day. Kerosene uses another quarter million (250,000) barrels a day, while residual fuel oil of the type used by industry employs another million and one-half (1,500,000) barrels per day. Lubricating oil products do not use such fabulous amounts, but also contribute to the total. In fact, industrial lubrication oils alone consume forty-four thousand (44,000) barrels per day.

Of all the petroleum products, aviation gasoline is the only item which shows a reduction over wartime demands, as even the use of petroleum as a raw product for other chemicals is increasing.

Use of petroleum at the rate indicated brings up the pertinent question of whether we are consuming our heritage of this valuable resource at a rate faster than justified. The consumption is high and perhaps unwarranted and even at the present time, the supplies are not quite adequate to meet the demand.

Crude-oil production is exceeding five million (5,000,000) barrels per day and should carry most of the nation's requirements. A bottle-neck has developed, however, in that the products cannot be moved in adequate quantities to and from the refinery centers which, in some instances, are overtaxed. The transportation bottle-neck means that certain sections of the country, particularly in the midwest, may suffer from inadequate fuel supply.

The long term viewpoint of petroleum must necessarily consider the question of total proved reserves which, at the present time, are in excess of twenty-four billion (24,000,000,000) barrels. A rough calculation, using the two billion (2,000,000) barrels per year current consumption, would indicate that these reserves are good for twelve years only. However, experience has shown that proved reserves have tended to increase with passing time instead of decrease, so that it is probable that twelve years from now our proved reserves may not be appreciably less than they are now. However, this condition cannot last forever, and the time will come when this country and the world will be faced with the stern realization that oil conservation is a serious necessity. It is not too early for this country to awake to a realization of that condition and start conservation now.

AS THE year approaches its end, your Editor hopes he may be pardoned for writing a few words about "Lubrication Engineering" itself. However, coming events may be of interest to our many new readers and to the members of A.S.L.E. With this issue, Volume III of "LUBRICATION ENGINEERING" is completed and this represents the last issue which will appear on a quarterly basis. Starting in 1948 the magazine goes to bi-monthly publication with six issues instead of the former four. The staff is very happy to make this change as it represents a sign of healthy growth. Such a backlog of fine papers is now available that it appears difficult for us to find room to print all we would like to, even in six issues. Along with the increased number of issues will appear a greater number of pages with more advertising and news of the industry.

Your Editor welcomes criticism from readers and would like to publish letters which might be of interest to the Industry and to the Society membership. Please feel free to express your thoughts at any time.

The Society, itself, is planning its third Annual Convention to be held at the Statler Hotel in Buffalo on April 19, 20 and 21, 1948. In addition to an extremely interesting group of papers which the Program Committee has already assembled, and which will be announced in the next issue, there will be held, concurrently with the Convention, an exhibition of lubrication equipment and lubricants. The exhibit space is in the Hotel, adjacent to the meeting rooms, so that all in attendance may see the exhibits and attend the meetings.

As this issue goes to press just before the Holiday Season, your Editor takes this opportunity of wishing a Merry Christmas and Happy New Year to all the readers of "LUBRICATION ENGINEERING."

B. H. JENNINGS, *Editor.*

Some Modern Aspects of Steel Plant Lubrication

By C. E. PRITCHARD

Chief Lubrication Engineer, Republic Steel Corporation, Cleveland, Ohio

PLANT managers, engineers, and operators are vitally interested in the correct lubrication of machines and equipment, for which they are responsible, but too often little consideration is given to changes involving plant expansion, increased loads, age, and design of equipment, and increased speeds, all of which contribute heavily upon the economy of the operations involved. Another singularly important point often neglected is that of providing adequate routine inspection of operations by a competent person who may be able to recognize the need for minor repairs which, if left unattended, generally result in a very costly delay in operation in addition to severe damage to the machinery itself.

It is the desire of the writer to deviate from the actual phase of selecting the type of lubricant to be used throughout the various operating departments of a steel plant by presenting herewith some of the more salient facts pertaining to good lubrication practice as applied to the method for properly maintaining the lubricating equipment, rehabilitation and inspection of bearings, and scheduling of the lubricant application.

Experience has indicated that where each immediate phase of applied lubrication is covered in detail, aside from the all-important decision of selecting the correct lubricant, considerable benefits have been enjoyed. By incorporating new developments, elimination of repetitive failures of lubricating equipment and operating equipment by a thorough study of the basic causes, and a thorough inspection of the equipment during operation, it will be found possible to reduce mill delays and replacement of parts to a minimum.

ITEM 1

Lubricating System Repair Stations

Although the benefits derived from provision of semi-automatic and automatic lubricating systems in the steel plant were found to be innumerable as compared to the previous method of hand gun and oil can lubrication, it was also learned that unless a rigid inspection of the functional operations of these systems was maintained they soon reverted from an asset to a liability. This condition proved to be quite serious in that the average operator believed, as the name would imply, adequate lubrication would be enjoyed so long as the system was known to operate. The added problem of crushed and damaged feed lines resulting from workmen stepping upon them also indicated the need for consideration of these eventualities during the period of installation of the system proper.

After considerable study, it was decided that the most feasible method of meeting this problem was to select one of our most outstanding mechanical men, adept at both machine shop practice and pipefitting, to head up the program covering both the inspection and rehabilitation of the damaged lubricating systems. To supplement his field experience it was arranged for the man selected to spend sufficient time at the factory of the equipment supplier to ensure his being able to assemble all the various component parts of both the semi-automatic and automatic systems including the pumps, measuring valves, check valves, switches, etc. A study of the methods used for checking the systems in operation also proved to be quite helpful to the repairman in meeting problems encountered in the field.

The next logical step was to select a centrally located point in the plant for the repair station and to provide the necessary tools to cover all the various types of repairs to be encountered. *Slides No. 1 and No. 2* show the first such lubrication system repair station completed within our organization.

The true value of such a station over and above being just a place where lubricating equipment was to be repaired soon became apparent. As you will note, a sample case was provided to display all the various types of lubricants employed throughout the plant. In addition, an attractive display of all the different

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lubricating appliances, seals and bearing material, provided a means for conducting lubrication classes therein. All mechanical and electrical maintenance men are now given the opportunity of learning how to properly disassemble and reassemble the various types of lubricating devices that they come in contact with. Considerable dividends have already been manifested by this educational program alone in that the tendency now is to make the necessary repairs immediately in the field rather than condemn the type of equipment for failure to function as was experienced previously with a resultant delay in operations and often times damage to equipment. Both correct and incorrect lubrication practices can be covered in detail by means of these comparative displays and lubrication classes. It is surprising to note the number of helpful suggestions that are proffered by the various maintenance men for improving the equipment as well as the repair station itself. Typical semi-automatic greasing systems are also displayed in such a manner as to show the many ramifications that can be encountered in the field. Cutaway sections of the measuring valves mounted adjacent to the system offers a means whereby the detailed functional operation can be explained during the instruction procedure.

A more recent innovation that has developed regarding the repair station has been to channel all lubricating fittings, devices, and equipment through this one focal point. In this manner, a standardization program has been made possible which in turn offers a means for enjoying complete control over all phases of applied lubrication. The considerably smaller inventory of fittings and devices made possible thereby entails less operating expense while excess consumption of fittings, hoses, and devices can be detected immediately with corrective measures being instituted whenever found necessary. Standardization of the type of pump used enables the possible replacement with a spare unit at a minimum of lost time. The damaged pump can then be returned to the repair station for rebuild without endangering any major operating unit due to the lack of lubrication while the pump is inoperative. Every piece of lubricating equipment is recorded by department on a master tab sheet maintained at the repair station. Routine inspection of the plant indicates the prevailing condition of each respective unit.

In most cases it has been found that the savings effected by rehabilitation of inoperative lubricating units alone has underwritten the first year's operating expenses of the repair station. *Slide No. 3* shows a fairly representative example of the conditions encountered during our initial drive for accumulating all lubricating equipment throughout the plants which were not in actual usage at that time. Quite often the units were complete in all respects with the exception of one or more minor parts, and after cleaning, replacement of the damaged parts, and painting, were returned to active duty. The cleaning of the damaged equipment has been accomplished in most cases with a minimum of effort by utilization of an existent solvent degreasing unit.

The measuring valves and filler tank have been returned to the repair station for reconditioning. A reserve supply of all equipment can be constantly rotated in this manner without necessitating a large and expensive inventory.

A modification of the lubrication repair station has been employed as a mobile unit where the extent of coverage has found to be quite extensive. In some cases it has been necessary to provide more than one station with the individual plant requirements usually dictating the need for same. In all cases where a clean and orderly repair station is maintained. the interest tendered by all the maintenance men towara correct lubrication application has been fostered to such an extent that mill delays and repetitive failures have been steadily reduced. Damaged circulatory oil pumps, hydraulic valves, and miscellaneous hose connections are gradually finding their way into these stations which undoubtedly points to the possibility of extending this service to many more unknown fields with added savings to the plant.

Where solvent degreasers have not been provided to facilitate the cleaning of parts received at the repair station, self-fabricated cleaning tanks have been installed. A two compartment tank seemingly offers the better method for this type of cleaning. Drain connections facilitate the removal of the cleaning solvent while the base is used for storage of cleaning brushes and rags.

Slide No. 4 illustrates one recommended procedure for filling hand guns and pump reservoirs on two types of lubricating systems. Contamination of the lubricant and infiltration of air into the units are virtually eliminated by this practice. It might be added that these two conditions probably cause the most commonly experienced difficulties noted during the period of application of the lubricant and emphasis should therefore be placed on correct procedure being employed during the loading cycle.

Inasmuch as a record is maintained of all shop work, it is very readily determined, where repetitive repairs are found necessary, that either further instructions, relocation of the equipment to a less vulnerable spot, or corrective measures are in order and immediate steps can be taken to cover same.

Testing of all reconditioned measuring valves, pumps, and gauges is standard practice before release from the repair station. *Slide No. 5* illustrates the testing of a hand pump after the necessary repairs had been made. A standard pressure gauge in this case also offering a means of checking the gauge mounted on the pump.

Bearings

Inspection and repair of bearings employed in the various operations of a steel plant is considered, and rightfully so, as being one of the most important phases of routine maintenance. The dollar value of the bearings

ITEM 2

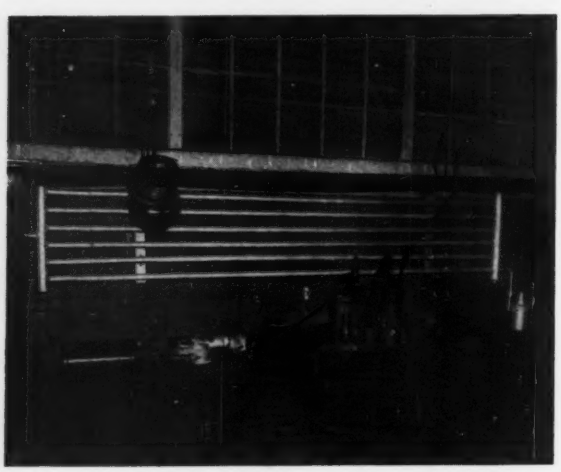
employed, for example, on a modern strip mill reaches a phenominal figure, and consequently, it is the opinion of the writer that no discussion of mill lubrication practice would be complete without due consideration being given to the proper selection and handling of bearings.

Inasmuch as the modern strip mill has already been mentioned, a resume of the prevailing practice for inspection and handling of bearings employed in this type of operation might be in order. Due to the heavy weight involved in handling both work roll and back-up roll bearings along with their respective chocks, it was found necessary to provide overhead crane facilities. Re-establishment of original chock dimensions were found to contribute considerably to better bearing life, hence this inclusion in the inspection program.

The equipment used in checking the tapered roller type of bearing in this case consisted essentially of a surface plate table, levelling table for clamping and gauging bearings, steam heated oil bath and drain table for cleaning bearings, necessary storage bins and racks for bearing parts, gaskets, oil seals, spacers, and miscellaneous items such as bolts and nuts. Storage space for new bearings within the confines of the bearing repair station assists materially in correct installation procedure being followed during the assembly operations. In addition to providing the necessary tools such as micrometers, surface gauges, hand grinders, etc., it was found advantageous to also provide either an air-operated or electric powered barrel type grease pump for loading the bearings before sending them out to the mill for service operation. The latter mentioned practice being considered mandatory with subsequent make up additions of lubricant being handled through the medium of the mill automatic lubricating system.

All work roll and back-up roll bearings and chocks are returned to the repair shop for complete inspection at least once in every six months. Special attention is given immediately to all bearings involved in mill wrecks, broken rolls, etc. Where four row assemblies are involved, the spacer ring is reground to compensate for normal wear differentials in bearing tolerances. A more uniform distribution of load being made possible thereby which, in turn, tends to increase their effective service life.

A complete history is maintained on a card record for both new and reconditioned bearings including the nature of repair and accumulative tonnages and time in the various locations throughout the mill. Oftentimes a study of these records reveal the need for mechanical changes which are virtually impossible to obtain in any other manner while the mill is operating.



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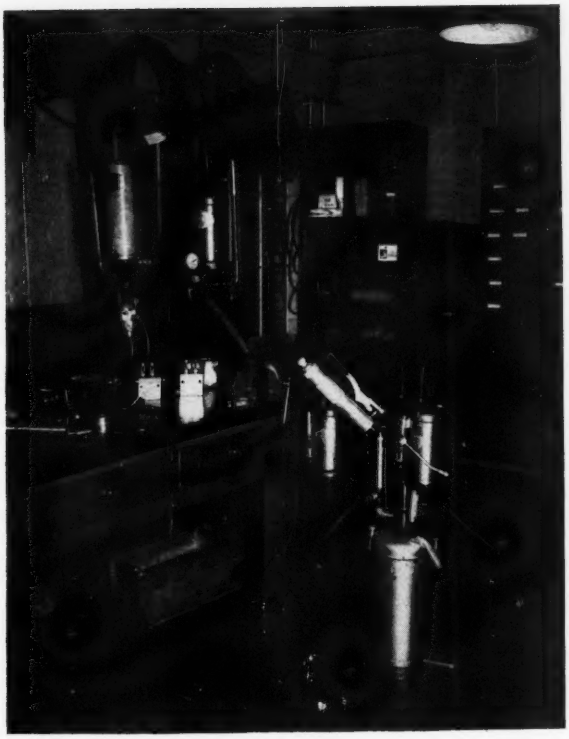
On tapered back-up and work roll bearings returned to the repair station, the rollers and cup assemblies are inspected and all spalled spots ground in such a manner as to eliminate any sharp openings or fissures remaining. Experience has indicated that where the sharp edged openings are subjected to the extreme pressures of the rolling operation a progressive enlargement of the opening has been noted. One theory projected in regard to a possible explanation of this development is that the lubricant enters into the opening, and presumably through a hydrostatic force resulting from the extreme squeezing action of the mating part under heavy pressures, tends to cause a lifting action on the metal surface at the edges of the opening. Where these sharp edges have been ground off, a definite lessening of the rate of enlargement of the opening has been noted during subsequent inspections.

Maximum bearing surface life can only be realized where the correct tolerances have been established prior to being subjected to service operation. It is therefore essential to include this practice in all routine inspection and rehabilitation programs covering mill bearings. As a means of minimizing confusion surrounding the re-grinding of more than one spacer ring at a time a numerical coding system has been established giving the exact finish dimensions involved. In this manner the correct spacer ring can be determined at once for the bearing in process at this particular time.

Usage of an anti-rust compound at this point eliminates the possibility of corrosion of the polished metal surfaces during the interim between the time the bearing leaves the shop and when it is actually placed back into service again.

A similar inspection and rehabilitation program has been instituted to cover the oil film type of bearing also employed in strip mill operation. Distortion of the bearing surface metal in this case will, if not corrected at the time of inspection, seriously affect the proper distribution of the oil film during subsequent mill service and consequently promote metal to metal seizure which, in turn, results in complete destruction of the bearing surface. With bearings of this design, the lubricating oil is introduced into the so-called work zone of the bearing by means of an oil wedge pocket. Where the surface metal has been distorted or wiped over the lead edge of these oil wedge pockets, it soon becomes apparent that an inadequate amount of oil film will be maintained between the journal and the bushing; hence, the recommendation for routine inspection of the bearings. Mill conditions generally dictate the frequency of the inspection periods.

Plain bearings of various types including babbit, bronze, cast iron, etc., have been employed for many years in the steel industry for a somewhat indeterminate number of service conditions. Despite all the experience and knowledge that has been accumulated throughout these many years, we are still faced with conditions surrounding several installations which very closely parallel the problems encountered years ago. A study of the correct procedure for installation of plain or sleeve bearings is one which offers considerable savings when properly adhered to and as a result will bear directly on the economy of various operations. All too often bearing



ITEM 4

service life is taken too lightly where plain bearings are employed because of the mistaken thought that because it is a plain type bearing that no improvements are necessary. Wherever repetitive failures are encountered, a thorough and detailed study should be instituted to ascertain whether the correct tolerances, surface finish, hardness, etc. have been provided consistent with good operating practice.

Lubrication Surveys

It has been said that no system is worthwhile unless it has been properly planned. The practice of applied lubrication in the steel plant would certainly bear out this contention. Modern machinery with its abundance of intricate mechanisms tend to aggravate rather than detract from this problem. Development and installation of the semi-automatic and automatic greasing systems along with the completely automatic circulatory oiling systems and a host of other individual lubricating devices have made possible the lubrication of mill machinery in a safe and economical manner without necessitating the need for stopping the machinery during the application cycle. However, the vast number of smaller units employed as an auxiliary function in the control and operation of the larger machinery does offer a definite problem regarding the application of the correct lubricant at the desired frequency. Very often these auxiliary functions are overlooked and prove to be more troublesome than the larger units.

The most effective method found to date in our organization for ensuring an all inclusive coverage, lubricationwise, has been the development of the lubrication survey and inspection program.

Departmental surveys are instituted for all the major operations which include a study of all the various points requiring lubrication, frequency of applying the lubricant, selection of the correct lubricant, method by which the lubricant is to be applied, who is to be allocated the responsibility of applying the lubricant if hand methods are employed, accessibility of lubricant supply to point of actual application, and methods for inspecting both the lubricating equipment and the mill machinery itself.

Some very interesting conditions were noted during the study of the above mentioned operations. Considerable time was found to be lost primarily due to the fact that the hand grease gun or oil can lubricant supply was exhausted when the oiler was at the opposite end of the building from the oil house. This necessitated, in general, the oiler walking the entire length of the mill and back before any further progress could be made in applying the lubricants. As a result of this type of lost motion it was found that several points of lubrication were not properly attended to at the frequency desired. A simple expediency in this case being to provide auxiliary supply depots at convenient locations in line with the oilers charted course. In fact, sufficient time was picked up by this simple change in practice to allow a detailed inspection of the equipment for misalignment, loose bolts and nuts, and leakage, all of which contributed to the reduction of costs and mill delays. A time study was provided to cover all the individual steps involved thereby making possible the allocation of definite points to be covered by each oiler in the course of daily operations. Several time consuming operations were also uncovered by these studies which justified the expenditure of money necessary to provide either

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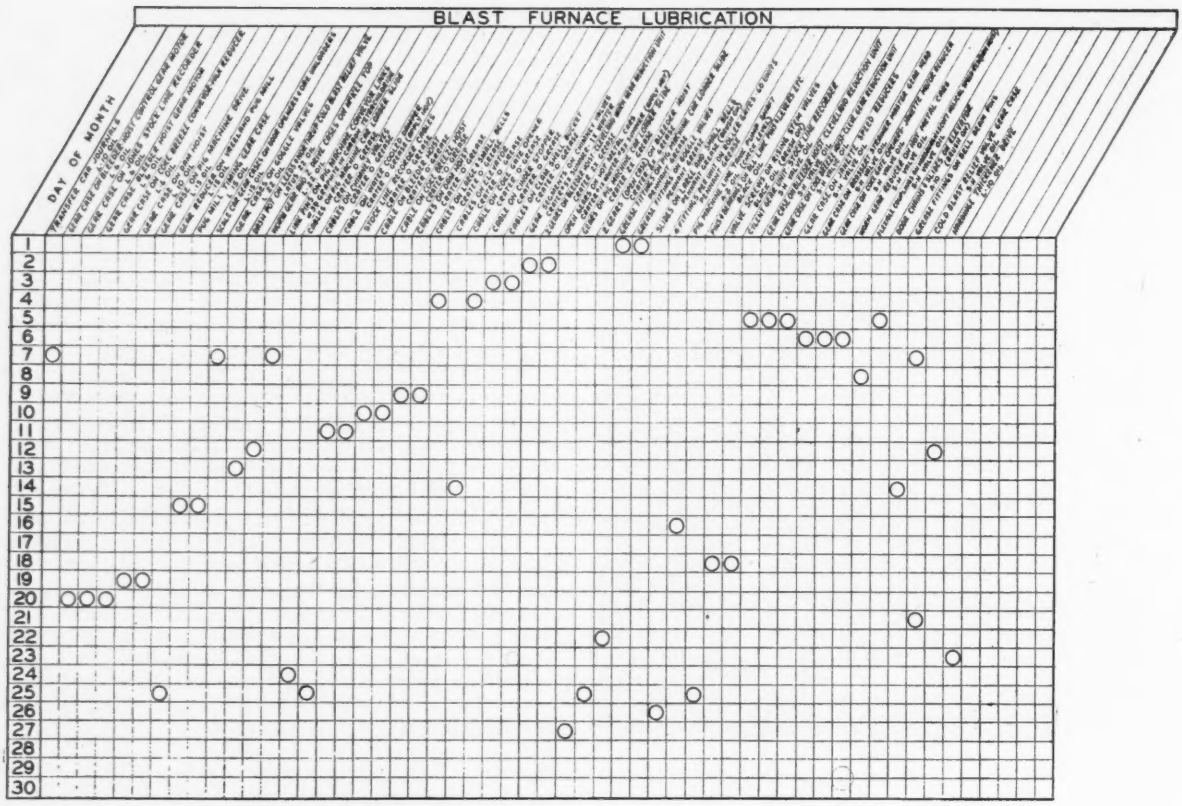


ITEM 6

semi-automatic or automatic lubricating systems. Inefficient mechanical designs were also highlighted to such an extent as to demand structural changes being made.

After the detailed information has been compiled covering the individual departments, a plan view of the entire mill roll train was drawn up and the various details inscribed thereon. In order to assist the oiler in determining just how many items he had to cover in the course of his daily routine inspections, a tabulation of the number of bearings and gear sets were included. Designation of the various operating units by their respective names, such as side shear, end shear, etc., plus designation of the furnaces by number and the sections of tables by letter seemingly eliminated any doubt as to their exact location and the extent of coverage desired. The actual lubrication schedule itself was set up for the three working shifts and included the type of operation involved, equipment used, kind of lubricant, and desired frequency. Responsibility for filling the reservoirs of the automatic lubricating systems was initially allocated to the machine operator, but after some adverse experiences was later bestowed upon the oiler.

A program of this type is readily applicable to both the older and the more recent mill installations. A savings approximately 50 per cent of the man hours previously needed for the lubrication of some of the older operations were made possible by the adaptation of this system of scheduling.

The lubrication of the more confined units of the steel plant such as the blast furnace, shops, etc., have been covered in a slightly different manner to date with equally satisfactory results. However, a study is being made at the present time to ascertain whether or not this latter mentioned plan can be improved upon, especially where inexperienced men are involved, by the inclusion of a skeleton drawing of the furnace and the auxiliary functions showing the location of the points of lubrication in question. As will be noted on the sample sheet covering the blast furnace, the various points of application are broken down on a daily basis with a circle inscribed for each point to be lubricated opposite the respective day of the month. The circle is provided to permit the individual placing his initials therein after the point in question has been lubricated. This program does offer the advantage of determining just which individual has performed the operation, but has the disadvantage of requiring the posting of a new sheet every month and maintaining a file record of the previous sheets.

Individual shops, such as machine, electric, boiler, etc., can be very effectively covered by the development of a general arrangement drawing for each individual machine upon which has been detailed the location of the point of lubrication, type of lubricant to be used, and the desired frequency. During the recent period of hostilities, the rapid change over of operating personnel gravitated into a very serious situation involving an excess of costly delays due to inadequate lubrication of vital equipment. As a consequence, the development of a simple and practical method for complete lubrication coverage was given considerable attention and evolved into the usage of decalcomania transfers of various sizes, shapes, and colors to indicate the location, lubricant to be used, and recommended frequency. In this manner it was quite simple for even an inexperienced employee to carry on with vary satisfactory results.

LUBE SPOTS

Correct lubrication may be summed up as "the right oil—in the right place—in the right way."

Too often, too much emphasis is placed upon the first two elements of this "tripod," too little on the third. It is only when all three elements have been brought into proper balance that correct lubrication has been achieved.

The fact is that developments in the method of applying lubricants have lagged behind the development of special lubricants for specific purposes. A trip through even the most modern plant will quickly prove that both manufacturers and operators have been slower to adopt new methods of application than to accept new kinds of lubricants. *And yet more dramatic economics in oil consumption, labor power and reduced maintenance can more often be accomplished by the use of relatively inexpensive devices than by the most painstaking selection of lubricants.*

Furthermore, quite contrary to the attitude of most engineers, a full understanding of the "right way" can result in substantial savings in all plants. The fact that machinery might be old or that the bearings are loose need not exclude them from consideration. Very often it is under just such conditions that greatest savings can be most quickly and convincingly shown.

Another point worthy of mention is that regardless of how suitable a lubricant may be for a given lubrication requirement, it cannot do its work unless it is distributed properly over the frictional surfaces. Unfortunately there is far too great a tendency to fail to consider that point in actual work with plant machinery. As a result many products ideally suited to the machinery and operating conditions are condemned simply because they are not suited to the method of application employed.

The number of devices now available to the lubrication engineer for correct application of oil or grease to a bearing gear or cylinder runs into the hundreds (possibly thousands). Only the four most common devices for all application have been selected for review.

The Oil Can

Very seldom in any plant, under any conditions need the oil can be an important accessory of lubrication. Only under very unusual circumstances is it impossible to replace the oil can by a more efficient method of application. This method of application should only be used on small unimportant points where it is impossible for practical considerations to apply automatic or semi-automatic devices.

The particular disadvantages of the oil can are: (a) the bearing receives too much or too little oil; (b) it is impossible to avoid waste through passage at the moment of application; (c) its effectiveness depends entirely on the regularity with which the oiler makes his rounds.

Wherever oil cans must be used, the thumb-actuated plunger type which delivers a measured amount of oil is recommended.

Maintenance Suggestions:

1 Oil cans should be kept in respectable repair, irrespective of age. Respectable repair is meant to include
   (a) periodic inspections for tightness, ease and correct functioning of the plunger mechanism and condition of the spout.
   (b) regular maintenance schedule for careful cleaning, to avoid accumulation of dirt or abrasive particles that might be carried into the bearing.
2 Every plant should have the necessary number and sizes of oil cans. They should be identified as to the oil contained, and control established to see that the proper lubricant is put into the can.

Be sure that different spout sizes are available to the oiler. *Always repair or replace* damaged, bent or "pinched" spouts.

The Drop Feed Cup

The drop feed oil cup is a gravity controlled feed type device. It is semi-automatic in that it requires manual control for starting and stopping.

The drop feed cup is used when a regulated flow of oil is desired and/or where a variable flow is desired over a wide operational range.

The drop feed cup consists of these members: oil cup, a needle valve, regulating screw, a sight glass, and a manual control for starting and stopping. This device is also made with more than one feed outlet with or without control over the individual feed. Theoretically, this type of oiling device answers all of the requirements for a perfect device. In practice, however, it falls far short of expectations.

The principal trouble usually comes from clogging of the small spindle or needle valve. Even very small or fine particles of foreign material are likely to seriously affect the rate of feed. Another problem encountered with this device is that machine operators can (and will) adjust the flow rate according to their own ideas of correct lubrication. Another circumstance adversely affecting the efficient operation of this device is oil temperature. Due to the change of viscosity with change of temperature the drop feed cup when set for given temperature condition may not permit sufficient oil to be fed should the temperature drop and conversely supply too much oil when higher temperatures prevail.

Maintenance Suggestions:

A regular service period should be established for maintenance of drop feed cups. This procedure should include

(a) thorough cleaning.
(b) inspection of needle valve for wear or damage.
(c) the drop feed cup should be tested for specific flow rate using the oil required for specific application and the flow rate set accordingly.

Note: Some manufacturers are now selling a drop feed cup where the adjustment mechanism is located inside the oil cup. The only way the feed can be adjusted is to disassemble the cup. Where "operator trouble" is a problem this may be a solution

Wick Feed Oilers

Among the many methods of feeding oil automatically, probably the oldest is that by means of a wick or pad of absorbent material.

All wick feed oilers are similar in that they make use of capillarity of some porous material. Due to the different kinds of wick feeds they are classified as the feed pad, feed and roller, and siphon, and bottom wick feed types.

The most common type and the one usually referred to as a wick feed oiler is the siphon type, and only this type will be discussed.

The principle of operation involves the action of a siphon in addition to the capillary action associated with wick feeds. The wick leads from an oil reservoir upward and over a partition and downward to a level lower than that of the oil in the reservoir. If capillarity is able to raise the oil up to the highest point of this wick, then both capillarity and gravity will cause the oil to flow downward on the opposite or discharge side of the wick.

In a wick of good quality (wool yarn of first quality) the absorbent power *will raise the oil 2 or 3 inches above the oil surface.* The force which actuates oil flow is the difference in height of oil in the reservoir and that of the discharge end of the wick. Maximum flow is usually obtained when the length of the wick is greater than 2 inches below the oil level. The wick feed cup consists of an oil cup with a central vertical tube, or standpipe, in which the discharge end of the wick can be placed. The depth of the cup *should not exceed* 2¼ inches and the length of the standpipe and also the wick should be *at least* 2 inches. A wire holder for the discharge end of the wick is sometimes used. This insures correct positioning of the wick at all times. Control of the oil feed to the bearing is governed by two factors; namely, the height (or head) of oil, and the number of wicks in the cup.

The more wicks used in a given cup will give greater feeds.

Factors which govern the correct use of wick feed cups are size, length and speed of rotating journals, direction of rotation and location of pressure area. Where severe vibration is involved, independent mountings or selection of another device should be considered.

Since the wick acts as a filter, clean oil is delivered to the bearing.

Maintenance Suggestions:

Regular maintenance schedule should be set up to provide

(a) inspection of condition and mounting of cup.
(b) cleaning of the cup.
(c) use only top quality wool yarn and clean regularly. A dirty wick restricts oil fed to the bearing.
(d) always saturate the wick with the oil to be used before placing it in service.

Bottle Oilers

A device that overcomes most of the objections to the drop feed oiler and combines some of the advantages of the wick feed cup is the bottle oiler. This device provides a reliable uniform feed over a wide range of service requirements.

A bottle oiler consists of three essential parts: a glass container or bottle, a tight fitting cap and a spindle. The bottle rests in the cap (usually the bottle is threaded) with a tight joint assured through the use of a cock gasket. The cap has a projecting sleeve drilled to permit free movement of the spindle. The spindle is a straight piece of round metal (usually steel), with one end flattened, the other end rounded. The flattened end is placed inside the bottle to prevent the spindle from dropping out.

In use the bottle oiler is placed in an inverted position and so supported from the bearing cap, nipple or tubing. Since the device is air tight and is inserted, oil cannot leak out unless air in the bottle expands or additional air enters.

When the temperature of a bottle oiler rises, the resulting expansion of the air in the bottle expels some oil. When the temperature falls the contraction causes air to enter the bottle. These temperature effects are advantageous, since in the case of a hot bearing the heat causes the bottle oiler to release additional quantities of oil.

When the shaft is stationary, and temperature is constant, no air enters the bottle and no oil is lost. When the shaft or journal is in operation, the spindle is given a motion so slight that it can scarcely be detected. This motion is sufficient to result in a pumping action, which causes the air to enter the bottle and the oil to leave at a very slow and constant rate.

Installations of bottle oilers having indirect contacts with revolving shafts or journals have been made successfully. Likewise mountings several feet from the point of entrance into the bearing, also successfully. Care should be taken to insure proper mounting and they should not be used when excessive vibration from other machines nearby will cause spindle vibration in an idle machine. Oil will be fed, thus destroying one economy always realized with bottle oilers; namely, minimum constant oil supply only when the machine is running.

Maintenance Suggestions:

A maintenance program for bottle oilers is very simple but necessary. This program should include

(a) inspection to insure proper mounting.
(b) clean the bottle regularly.
(c) clean spindle and cap so that the spindle moves fully.
(d) inspect rounded end of spindle — remove burrs or flat spots.

Conclusion

The advantages of using devices such as the drop feed cup, bottle oiler, wick feed oilers, etc., are many. The benefits which the user will enjoy from their correct use can be summed up as follows:

1. Reduced oiling labor cost.
2. Better lubricated bearings, thus reducing wear and repair costs.
3. Reduced oil consumption.

The adoption of these devices will permit the lubrication engineer to realize better plant lubrication with all of the latter's benefits.

WANTED—Automotive Lubrication Engineer. For technical service to fleet and dealer accounts by marketer of nationally distributed line automotive oils and lubricants. Must be willing to travel large part of the time. Excellent opening for good man. State experience, age and salary desired. Photo desirable. **Box 713, Lubrication Engineering.**

The Chicago Journal of Commerce with an AP date line of Oct. 3rd brings out the fact that ball and roller bearing sales rose to a peacetime average record of more than $20,000,000 a month in the first nine months of the current year. This was reported by George Carleton, president of the Anti-Friction Bearing Manufacturers Association.

The new peacetime markets have boosted the annual sales figure 250 per cent above 1937.

These are significant figures to the lubrication engineer.

Lubricants and Bearings for Turbines

By F. C. LINN

General Electric Company, Schenectady, N. Y.

THE lubricant and the bearing design for turbines are dependent upon a number of factors, each of which deserve consideration. Analysis of the functions and duties of each is important.

The oil is supplied under pressure to the governor hydraulic system to actuate the steam valves, and that which goes to a bearing is used as a lubricant and also as a means for carrying away heat. Oil is passed through an oil cooler to remove the heat and controls the inlet temperature to the bearings, to which it is supplied at 10 to 25 pounds pressure and 110—120F temperature. It may be contaminated with water. It should have low viscosity during normal operation, and higher viscosity during operations on the turning gear. It is usually thoroughly mixed with air in the bearings, so that it is oversaturated and thus foaming when discharged from the bearings.

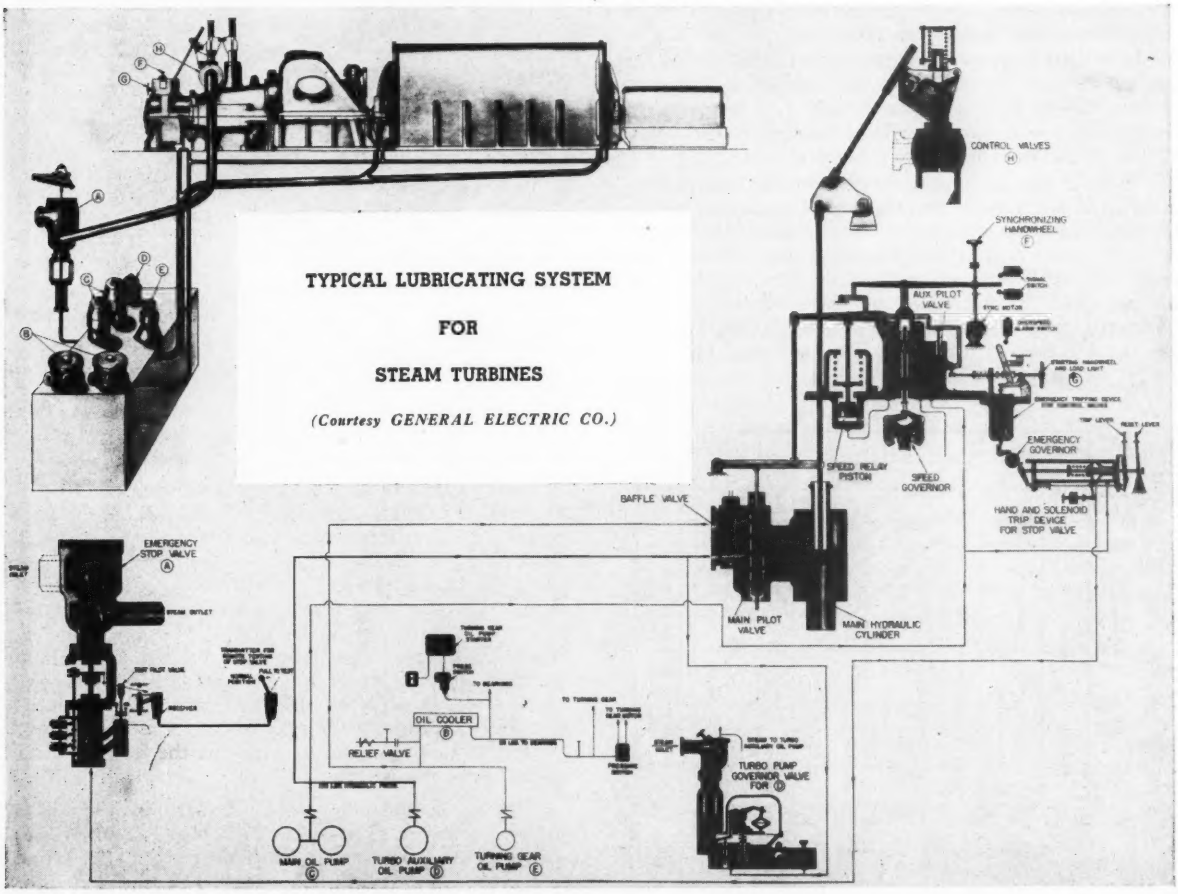
The bearings themselves are designed to operate with minimum loss consistent with good practice. They have ample safety factors, and operate with relatively low clearance, so they should be supplied with oil that is free from foreign matter.

Lubricating Systems

Fig. 1 shows a typical lubricating system for General Electric large steam turbines. (B) are oil coolers mounted in the tank, and (C), (D), and (E) are pumps for the various lubrication requirements during the starting and operating cycles of the unit. The pressure oil pipe is enclosed so that in case of a leak, it drains back to the oil tank, thus eliminating the possibility of a fire hazard. The return piping is of ample size and slope to drain oil from each of the bearing pedestals and discharge it into the oil tank. Pressure oil is used to actuate the hydraulic system and position the control valves. (Valve A is the main steam line stop valve.)

A typical oil tank has a sloping bottom with the oil cooler mounted on the side of the tank and an auxiliary oil pump mounted on a shelf and extending inside the tank. By the use of a sloping bottom and a V at the lowest point, it is possible to drain the tank and remove the water and other foreign matter which may accumulate.

Water can get into the oiling system from the turbine gland seals and form condensation during the shutting down cycle.



Presented at A.S.L.E. Annual Convention, Pittsburgh, March, 1947.

Viscosity Requirements

Fig. 2 is a viscosity temperature chart of oils which are normally used on turbine sets. Oil of 150 sec. at 100 F is used for land turbines. Oil of 320 sec. is used for geared sets with generator drive and oil of 500 sec. at 100 F is used on geared sets for propulsion and other drives where pulsating loads may be encountered. This chart shows the effect of a change in the temperature on the viscosity of the oil. Normally, units should operate with inlet temperatures of from 110 to 120 F and with outlet oil temperatures of from 140—160 F.

Under normal operation, it is advisable to maintain a temperature within the ranges indicated above in order that the oil may have long life and so that the power loss will be kept to a minimum. Some oil company representatives have advocated running with lower inlet temperatures in order to increase the life of the oil. A decrease in 10 F in the average oil temperature in a bearing increases the bearing loss approximately 10 per cent.

In order to give an idea as to what this means, the bearing loss on a turbine generator set varies from approximately 0.5 per cent to 1 per cent of the full load rating. On the larger units such as 50,000 kw, the bearing loss would be 0.5 per cent or less and on smaller unit such as 2,000 kw, approximately 1 per cent. On geared sets bearing loss may be between 2 to 4 per cent of full load rating. Based upon above figures, customers can estimate the variation in cost of operation due to reducing oil temperatures and should find that operating costs due to reducing bearing temperatures exceed oil cost due to more frequent changes of the oil when run at indicated temperatures.

It is advisable to keep the temperature within the ranges indicated above since the babbitt temperature is from 30—50 F higher than the outlet oil temperature. It is advisable to keep the babbitt temperature below 210 F to maintain satisfactory physical properties.

When large turbines are shut down and started, it is advisable to have them operate on a turning gear, in order to keep the shaft from bending due to differential temperatures which exist in the turbine casing while it is still hot during the shut down cycle. It is also advisable to make sure the shaft is straight during the starting up cycle. When the rotor is operating on the turning gear, it is running between 1 to 3 rpm, and under this condition it is essential that oil of a viscosity of approximate 200 sec be used to keep the bearings from wearing.

By cooling the oil to the bearing to between 85 and 90 F a viscosity of 200 sec will be maintained.

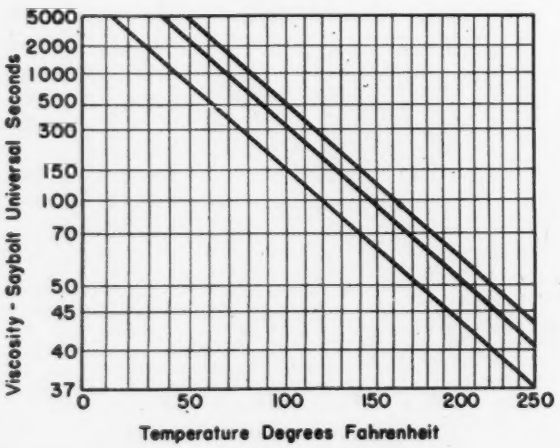


Fig. 2 *Viscosity-temperature chart*

Recommended Types of Oil

Previous to 1938, most of the oils on the market were highly refined hydrocarbons with no inhibition, and for our discussion we will refer to these as conventional oils. Since 1938 most of the oil companies have developed rust and oxidation inhibited oils, and for this paper we will refer to these as inhibited oils.

During the late 'twenties and the 'thirties, conventional oils were being sold on the basis of long life operation, and prospective customers were bombarded with the sales talk that if they would install a particular oil they could expect to operate the unit for 20, 40, or 80 thousand hours before replacement.

Many installations were operated with a brand of oil in the system for these lengths of time. One such case will illustrate how this was accomplished. In this particular installation there are two turbines which for the past 20 years have not had a new batch of oil. Every two weeks oil is removed from one of the turbines and put in a batching tank, and the oil from the batching tank put into the turbine lubricating system. When the neutralization number arrives at from 1.5 to 1.8, the batch is sweetened by drawing off some of the old oil and the addition of new oil. So for the past 20 years these units have been operating "without a change of oil."

Many people are continuing to use these conventional oils with more or less success depending upon the amount of reclaiming by filtering and the amount of sweetening with new oils. This can be done successfully in the larger installations due to the employment of technical personnel to see that the oil is properly cared for in order to operate for long periods of time. In some of our installations where technical ability is not employed, very serious conditions sometimes result in having the system sludged badly, which requires that the unit be taken out of service and the oiling system completely cleaned.

During the latter part of the 'thirties, considerable rusting difficulties were experienced in systems using conventional oils. Fig. 3 shows black oxide rusting in the inside of the lower and upper half, respectively, of a return piping and outside of the pressure piping. This is on a unit which had been in operation a few days. It took considerable time to clean the system up.

Rusting difficulties were particularly noticeable during the 'thirties in the governing system, where the pilot valves and operating pistons would be coated with black oxide and eventually stick and result in erratic or unstable governing. In such instances it was necessary to close down the unit and do a complete job on the governor mechanism. This difficulty was usually experienced on new installations or on old installations immediately after cleaning out a system and the supplying of a new batch of oil. During this period, the oil did not preferentially wet the steel surface, and if water was present (usually the case) rusting in the form of black oxide frequently resulted.

The above difficulties were called to the attention of the oil producers. They were encouraged to supply oils which would have long life without continual reclamation procedures, and to eliminate the rusting difficulties as explained above. Most oil companies who supply

turbine oils today are marketing inhibited oils which meet these requirements.

In 1940, the A.S.T.M., Committee D-2, re-organized Technical Committee C to study and set up test procedures for the determination of various factors influencing the life and operation of turbine oils.

Fig. 4 shows three test samples which have been run in accordance with the A.S.T.M. rusting test procedure —Tentative Standard D665-42T. This test is conducted with 300 ml of oil and 30 ml of distilled water held in a bath at 140 F and stirred continuously for 48 hours with the steel test sample suspended from the cover of the beaker.

Sample A has been run in an oil with proper rust inhibition, Sample B in an oil with inadequate rust inhibition, and Sample C with no rust inhibition. If only a small spot of rust appears during this test procedure, the oil is adjudged unsatisfactory.

Oxidation testing has been carried on with slight modifications in accordance with the procedure as outlined on Page 17 of the September, 1943, issue of the A.S.T.M. Standards.

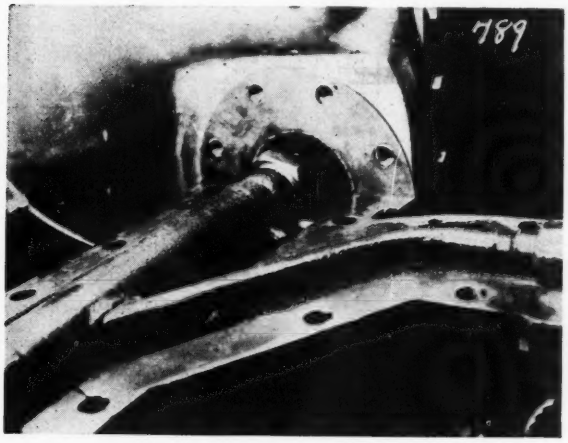


FIG. 3

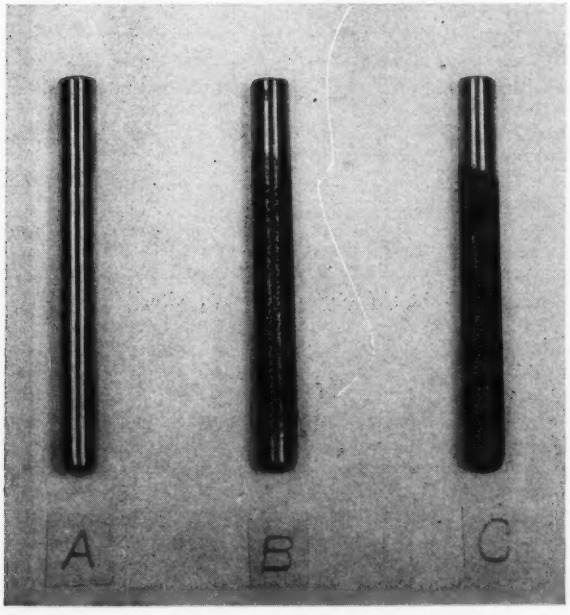


FIG. 4

This test is run with 300 ml of oil and 60 ml of water at a temperature of 95 C, with three liters of oxygen per hour bubbling through the oil. The copper and iron oil catalyst coils are of equal amount, in order to be comparable to the metal conditions as experienced in most turbine lubricating systems.

Fig. 5 shows a plot of acid number of two oils in this oxidation test. One is a conventional oil and the other is a double inhibited oil. Here it will be seen that the inhibited oil has materially longer life during this test than does the conventional oil.

In addition to taking readings of acid number, interfacial tension tests were made in accordance with the procedure given on Page 20 of the September, 1943, A.S.T.M. Standards for determination of interfacial tension of oil and water. Here it will be seen that the break in the interfacial tension curve is slightly ahead of the break in the acid number curve for the inhibited oil, and so gives a warning that the inhibition period of the oil is near its end.

Recently oxidation tests were run on a series of seven inhibited oils, each test made in duplicate. The color of the final samples of oils with water after 1,000 hours in the oxidation test along with the catalyst coils is darker in every case. The acid number of all the oils was still below 0.1; however, other changes had occurred. There appears to be a marked change in color in some of the oils and very little in others.

Some of this change is brought about by the change in the oxidation inhibitor, and has no particular meaning so far as the quality of the oil is concerned. In addition to color change, some of the samples had a certain amount of foreign matter, which may be termed sludge, present at the end of the test. Some of the catalyst coils show marked signs of rusting, whereas others show very little rusting.

Inhibited oils have been used for a sufficient period of time to prove their worth. However, inhibited oils will not give long, continuous, and satisfactory life if operated under adverse conditions, such as, a blowing high pressure seal. For normal turbine operation we would expect long life without rusting or sludge formation in a turbine system.

In installations with which the writer is familiar, two turbines were installed approximately six years ago. Water washing and centrifuging equipment was installed at the date of the installation. Since that time, this equipment has been moved to another location. There has been approximately 25 gallons per year make-up used in each system holding approximately 600 gallons. The main reason for the make-up is for the oil which is taken out of each system once a month for sampling purposes. The oil is still in excellent condition and it is expected that there will be many more years of satisfactory service from it.

The question has been raised as to what recommendations the A.S.T.M. has for testing to determine the remaining life of an oil in the turbine lubricating system. This request has been brought about because many turbine installations shut down at 1, 2, or 3-year intervals for inspection and repair purposes, and a power company's operators wish to know whether they should replace an oil during the repair period or whether it will go until the next one.

Technical Committee C of the A.S.T.M. recommends that the Oxidation Test be submitted to the Power Station Chemistry Subcommittee of the Prime Movers Com-

mittee of the Edison Electric Institute as a useful tool for measuring the oxidation characteristics of turbine oils. This test has been tried only on new oils and no data are available on its suitability nor on what limits should be set when using it to predict the further life of used oils.

Such applicability and limits can only be obtained by experimentation, which it is felt the operators are in a position to conduct. It would be appreciated if such data as are obtained be given to Technical Committee C. It is hoped that within the next few years considerable data will be obtained along this line so that Technical Committee C will be in a position to make a definite recommendation as to how to use the oxidation test procedures to predict the remaining useful life of a batch of oil in a turbine system.

Interfacial tension testing is being carried on by some of the utilities to determine when they should remove a batch of oil from the system or if in case of not being able to shut down the unit for a period of time, to sweeten the oil so as to eliminate the possibility of sludge formation. Interfacial tension testing as a means of determination as to whether or not an oil will sludge or form emulsions in the near future, can only be determined by periodically taking samples and studying the characteristics of the oil by experienced personnel. This can either be done by an oil user's laboratory, an oil supplier's laboratory, or an independent laboratory where the chemists have had considerable experience along these lines.

Care of Oil

It is suggested that arrangements be made by the turbine operators with the oil suppliers to have the supplier test the oils periodically and make reports as to satisfactory continued use of the oil.

It is suggested that a centrifugal or non-activated type of filter be installed in the lubricating system so that any time foreign matter or water gets into the lubri-

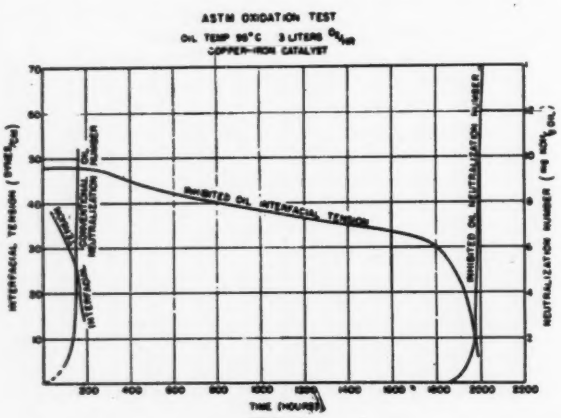


FIG. 5

cating system it can be quickly removed. A periodic inspection of the centrifuge or filter will also tell whether sludge is beginning to form, and so give warning that action has to be taken.

There has been considerable discussion as to the use of water washing and activated filters in connection with the use of inhibited oils. It is suggested that the action taken by Section I of Technical Committee C, D-2, of the A.S.T.M. at their June 24, 1946, meeting be followed. This is as follows:

"The committee went on record against Water Washing oils containing rust and oxidation inhibitors since experience indicates such practice may cause some reduction in inhibitor content. The only exception to this recommendation might be in the case of contamination of the rust and oxidation inhibited turbine oil with corrosive materials which are water soluble. The committee sees no objection to water washing straight mineral turbine oils if such practice is desirable to remove corrosive materials, oil deterioration products, or potentially corrosive contaminants. It is recommended that, where water washing is employed, the water have a pH of 6.5-8 and a conductivity of 2-5 microhms."

"The committee went on record against the use of Clay Filters with rust and oxidation inhibited turbine oils since experience indicates such filters will remove the rust inhibitor and some types of oxidation inhibitor from present day rust and oxidation turbine oils."

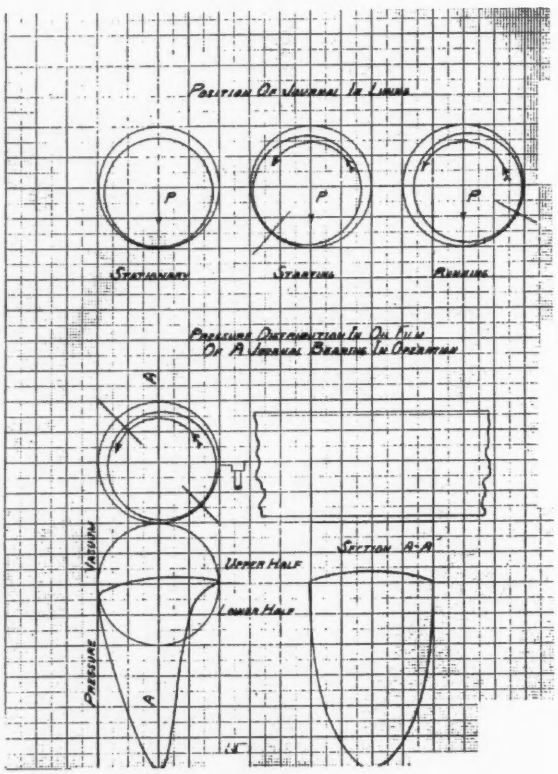


FIG. 6

Journal Bearings

Journal bearings are designed to operate for long periods of time with satisfactory service. Fig. 6 shows the normal operation of the shaft in a bearing under the conditions of standing still, starting, and running. Here is should benoted that for high-speed journal application for a normal bearing, a vacuum exists over the top half, and as stated previously, draws a considerable amount of air into the lining and mixes it with the oil.

In general, the maximum pressure in the lower half is in line with the applied load, and is equal to from

2 to 3 times the average pressure, as determined by dividing the load by the projected area of the bearing.

Fig. 7 is a cross-section of a bearing showing the grooving and the feed. The oil inlet orifice restricts the flow to the bearing to give an expected 30 to 35 F rise when the bearing is operating at normal speed. End. grooves with drain holes are used to accumulate the oil which leaks from the end of the active surface of the bearing, and discharges the oil to the pedestal so as to prevent oil leakage between the shaft and the oil deflector.

In general, high speed bearings which operate at 8, 10, or 15,000 rpm should have a greater clearance per inch of diameter than do bearings that operate at lower speeds, in order that sufficient quantities of oil can be put through them to keep the temperature within 30 to 35 F.

Bearing loads are normally between 150 and 250 pounds per square inch on turbine applications.

On some of the higher speed equipment, low-frequency vibration, normally called whipping, is eliminated by the use of various designs of bearings. One such design is the tilting pad bearing. Such bearings have proven their worth to eliminate whipping where the energy supplied to produce the whipping comes from the oil film. When is comes from other sources, this bearing is not sufficient since it does not act as a dampening medium. However, in most cases whipping has been produced by the action of the oil film, and this bearing has been very effective in the elimination of whipping in those cases.

The power loss in high speed bearings has been studied and an article published on this subject in the October, 1940, issue o fthe ASME transactions.

Thrust Bearing Design

A taper-land thrust bearing has been used successfully for the past 17 years in equipment from fractional horsepower rating to the highest rating equipment built. The thrust runner moves relative to the stationary babbitted plate in such a manner as to carry the oil up the inclined surface, thus producing an oil wedge which supports the thrust load.

There has been some recent discussion regarding the use of parallel thrust plates; that is, where the babbitt is parallel to the runner. It has been proven that successful operation can be obtained on plates where the speeds are high and where the radial depth of the plate is relatively narrow.

The experience with such constructions indicates that on large plate, due to thermal expansions, wiping of the babbitt will be obtained near the mean diameter of the plate, which ultimately results in thrust failure. It is recognized that if the two surfaces are parallel, large loaded carrying capacity can be obtained due to thermal expansion of the oil.

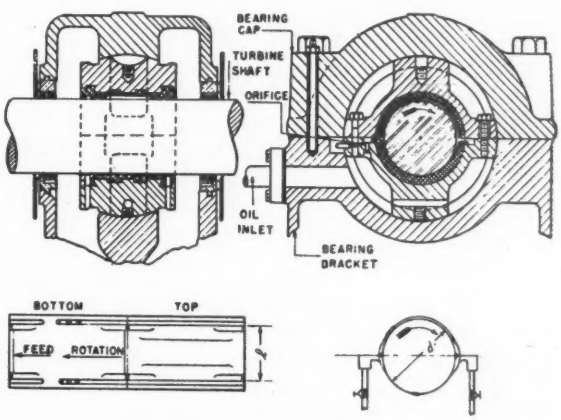
On the other hand, if the two surfaces are not parallel but are diverging, the load carrying capacity is nil and if converging at a small angle, the load carrying capacity will be as good if not better than flat surfaces. Therefore, it is suggested that at least the leading 50 per cent of the land be made with a tapered construction in order to be sure to get satisfactory oil feed and load carrying capacity. A taper-land thrust bearing has a very distinct advantage over other construction, in that oil is fed radially along the grooves. A drain groove is provided at the ends of the radial feed grooves so as to discharge some oil continuously. In this manner, cold oil is used as a scavenger for the hot oil discharged circumferentially from each of the lands to the grooves.

Babbitts

Tin-base babbitt has been used and is continuing to be used on turbine bearings. It is a pliable material which does not have catalytic effect on the oil used, nor do the acids formed in the oil react with the tin.

During the war, a considerable number of lead base babbitts were used for other installations. Most of this type of babbitt had a composition of 1 per cent arsenic, 1 per cent tin, 15 per cent antimony and 83 per cent lead. These babbitts are catalysts, that is, they increase the oxidation rate of the oil and after the oils are oxidized, the acids react with the lead to form lead soaps, thereby increasing the clearance of the bearings. This condition is not serious until a neutralization number of approximately 1 is reached. It is more serious in the presence of water than when water is not present. Laboratory experiments indicate that by increasing the tin content to 7.5 per cent there is no catalitic effect and the rate of reaction on the babbitt to produce lead soaps is approximate 10 per cent of the rate when 1 per cent tin is used.

Aluminum alloys have been used successfully in other applications, and have been tested for turbine appli-



SHAFT BEARING

cation. In most respects, the aluminum alloy is as satisfactory as tin in the bearing. In one respect, scoring of shafts if foreign particles are present, it is not as satisfactory. If there are small particles of foreign matter in the oiling system, they do not readily imbed in the aluminum, but are held in position and score the shaft to a considerable extent, whereas with tin or lead babbitts, the particles imbed in the babbitt and do not score the journals to the same extent. For other types of application such as motors, etc., aluminum alloys should prove very successful. However, for turbines we will continue to use the tin base babbitts.

Bronzes have been used only on those installations where it has been impossible to keep the temperature of the bearing below 210 F. The main objection to bronze bearings is again the scoring problem with foreign matter in the system. Also, if oil-film failure occurs, there is a definite likelihood of shafts scoring with bronzes, whereas there is little likelihood with either tin, lead, or aluminum bearing materials.

Mineral Lubricating Oils*

PART 2

By EDGAR S. ROSS
Sun Oil Company, Philadelphia

VII. Uses for Lubricating Mineral Oils

(a) General:

In the present discussion we are primarily interested in the heavy petroleum distillates having lubricating characteristics. Some borderline uses where lubrication is secondary or almost non-existant include:

White Oils
  Technical—
    Emulsified Spray Oils
    Bakers Machinery Oil
    Candymakers Oil
    Fruit Packers Oil
    Egg Packers Oil
    Slab Oil
  Medicinal—
    Internal Lubricant
    Salves
    Creams
    Ointments
Saturating Oils
    Wool Oils
    Twine Oils
Emulsifying Oils
    Cutting Oils
Electrical Oils
    Cable Oils
    Capacitor Oils
    Transformer Oils
    Switch Oils
Flotation Oils
    Metal Recovery Oils
Tempering Oils
    Heat Treating
    Quenching
Floor Oils
Railroad Oils
Dust Laying Oils
Ink Oils
Black Oils
Cutting Oils
Textile Oils
Hydraulic Oils

The major uses specifically as lubricants, include the following:

Motor Oils
Spindle Oils
Household Oils
Compressor Oils
Gear Oils
Ice Machine Oils
Meter Oils
Journal Oils
Cylinder Oils
Valve Oils
Turbine Oils
Grease Oils—and many others

VIII. Selection of Proper Refrigeration Compressor Lubricant

Until the coming of domestic refrigeration "ice machine oils," as they were usually called, were given very little special consideration. This was because the older types of ammonia and carbon dioxide machines could be lubricated efficiently with ordinarily good lubricating oils and were no more of a problem than pumps or gasoline engines. The household unit, however, introduced something new. First of all it demanded long service without any maintenance attention; secondly, it led to the wide use of a number of refrigerants that had previously been of little practical importance. These two things made the durability of oil much more important and also called for oils having properties not previously demanded. At about the same time, changes were taking place in commercial machines. Higher speeds, lower temperatures and improved efficiency were being called for.

This meant that the lubricating problems in the refrigeration field became of more importance. Oils which had been satisfactory were no longer quite good enough. High grade ammonia oils failed completely when used for sulfur dioxide, and various other difficulties appeared. So refiners were stimulated to turn their attention to a branch of their business which, while very old in one sense, had suddenly become quite new in another.

*Continued from September Issue.

Refrigeration oils today should possess the following essential qualities:

1. Must maintain a good body even at fairly high temperature.
2. Must have good fluidity and form an effective oil film at the lowest temperatures encountered.
3. Must be free from carbonizing tendency when exposed to so-called "hot spots" in operating systems.
4. Must not throw out sticky, waxy deposits at low temperatures.
5. Must not react chemically with refrigerants.
6. Must separate rapidly from the refrigerant.
7. Must be free from all but traces of moisture.
8. Must have extremely low pour and floc points.
9. Must be neutral and non-corrosive and remain so in service.
10. Must possess unusual degree of stability in service, thus assuring long life.

Perhaps the severest application has been with sulfur dioxide because this refrigerant forms sulfurous acid if it is in the least damp. Also even without dampness, sulfur dioxide will affect many otherwise good oils, forming yellow gummy substances, which will clog nozzles or stick valves. Even in the very best of oils, complete immunity to damp sulfur dioxide has not yet been obtained, but the other problem has been solved. Of course, dampness in the oil is just as bad as dampness in the refrigerant; so good oils are given a special drying process before being sealed in packages.

Oils absorb minute amounts of water from the air. So in handling oils, particularly for use with sulfur dioxide, it is important to keep the package sealed tight. It is also wise to store oil in dry and warm quarters. None of the other generally used refrigerants react with good oils chemically, but dampness causes the oil to lose some of its low temperature qualities. Water present will freeze out and can easily cause mechanical trouble. So it is always wise to take the greatest precautions to keep dampness out.

In actual practice the lighter grades are, of course, used in the smaller machines, and heavier grades in large units. Higher operating temperatures due to higher pressures or heavy duty requirements call for the use of heavier oils, as does the use of refrigerants that have a diluting effect on the oils due to high miscibility and/or mutual solubility. Furthermore, machines with rotary pumps will require heavier oils than reciprocating or piston-type compressors.

The precise selection of any specific grade will, therefore, depend upon design, capacity, operating conditions and type of refrigerant used, these conditions being quite accurately known, as a rule, so that exact grade of oil best suited can be forecast without too much difficulty and a minimum amount of experimental investigation.

IX. Effect of Refrigerants on Lubricating Oils

Frequently lubricating engineers and salesmen are confronted with operating problems for which the manufacturers or operators of refrigerating equipment might be inclined to blame the lubricating oil and even

condemn the grade or brand of oil they are using. It is our experience that quite frequently in such cases mechanical conditions of the equipment need to be adjusted to special operating conditions, that water has entered the system and caused the trouble or that the refrigerant used had an adverse effect on the lubricating oil.

Extensive research carried out over many years in various laboratories has revealed the importance of oil-refrigerant relationship such as miscibility, solubility in both the liquid and vapor phases, emulsibility and the effect of pressure and temperature on this relationship.

The various refrigerants used at the present time have different effects on lubricating oils.

Ammonia (NH_3):

Anhydrous ammonia has practically no effect on a well-refined lubricating oil. Due to its low solubility in oil, it does not lower the viscosity of the refrigerating oil. In the presence of moisture, however, ammonia will emulsify with oil at the prevailing compressor temperature. Therefore, the oil should be "dry" and care must be taken that water be kept out of the system to prevent freezing in the expansion coils, with consequent shutdowns, and the formation of oil emulsions which might cause considerable difficulty.

Carbon Dioxide (CO_2):

Carbon dioxide has no effect on oil since oil is not soluble in this refrigerant. Good lubricating oils have a sufficiently high flash point to prevent the formation of vapors which might be carried along with the refrigerant.

Sulfur Dioxide (SO_2):

Sulfur dioxide must be perfectly dry before it is introduced into the system, because this refrigerant is very soluble in water, forming a strongly acidic and highly corrosive solution. The lubricating oil likewise must be practically free from moisture (dehydrated) for the same reason.

Sulfur dioxide is not fully miscible at ordinary temperatures with pure lubricating oils and will not reduce its viscosity. Since SO_2 is a selective solvent, only carefully refined and filtered oils should be used for the lubrication of units using SO_2 as refrigerant. Otherwise the oil will be affected and form a gummy sludge which will settle out, clog nozzles or cause valve sticking and so obstruct efficient operation of the system.

Halogenated Refrigerants:

The newer types of halogenated refrigerants do not react chemically with a high-grade well-refined refrigerator oil. They are miscible with the oil and lubrication is performed by a mixture of oil and refrigerant.

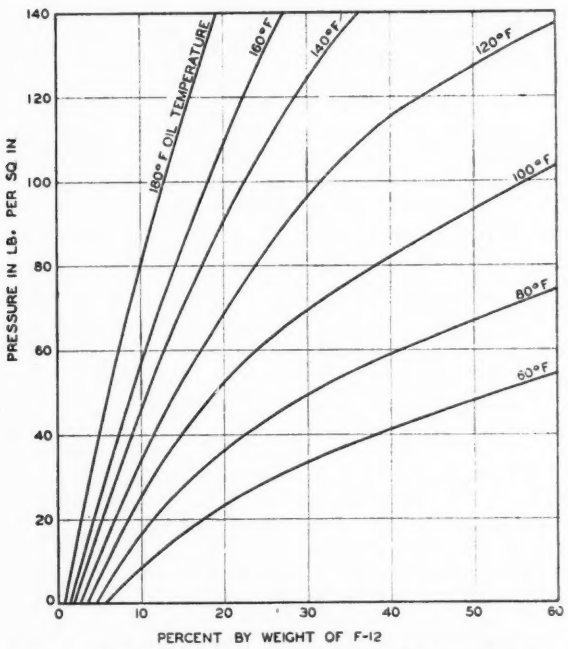


Figure 1.* Solubility of Refrigerant F-12 in Oil as a Function of Oil Temperature and Refrigerant Pressure.

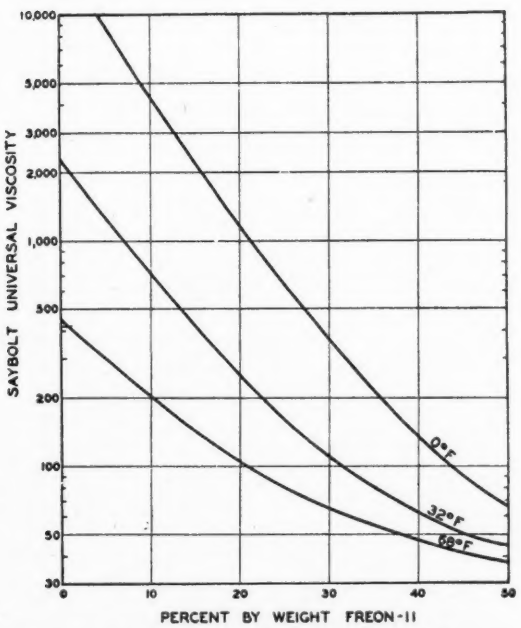


Figure 2. Viscosity of Oil of Figure 1 with Various Percentages of Freon-11.

**Cuts reproduced by permission of the American Society of Refrigerating Engineers from the "Refrigerating Data Book."*

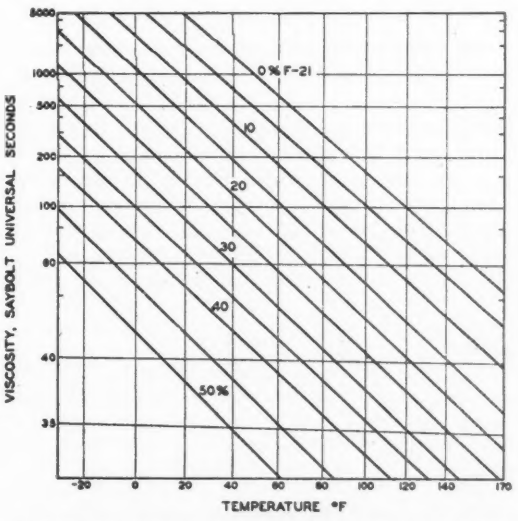


Figure 3. Viscosity Temperature Curves of Solution of Freon-21 in Oil.

Freon Group:

The Freons are completely miscible in mineral oils over a wide temperature range and consequently will reduce the viscosity of the oil. Therefore, an oil with sufficiently high viscosity has to be used so that after dilution proper lubrication will be provided.

The dilution effect on viscosity when Freons are admixed, as well as the solubility relationships under various conditions of temperature and pressure, have been rather extensively studied.

It has been found that some oils show separation of wax at various degrees on cooling, and that Freons have a reaction on certain oils which in some cases causes separation of wax. A criterion of the quality of oil in this respect is obtained by the floc test previously described and the amount of increase in wax separation at –35 F over that obtained at –10 F by the standard Methyl-Ethyl-Ketone method.

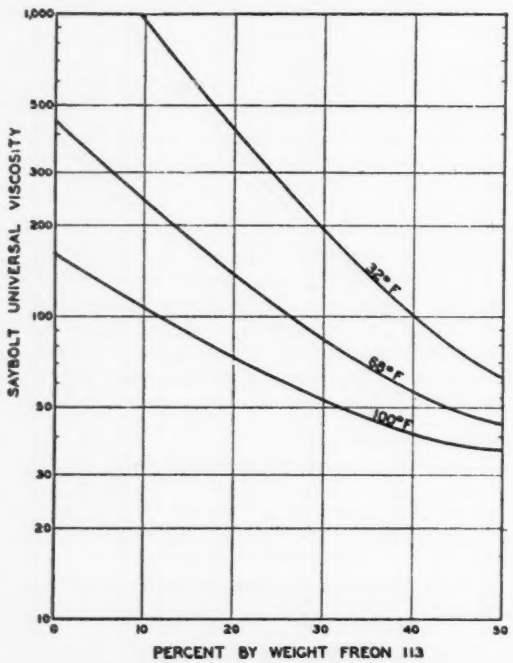


Figure 4. Viscosity with Various Percentage of Freon-113.

The effect of Freon refrigerants on the viscosity of the oils is of fundamental interest to the refrigerating engineer and affects the operation of a refrigerating unit, since the refrigerant must carry not only a sufficient quantity of lubricating oil to the moving parts but the oil must have sufficient viscosity to properly lubricate the equipment in spite of dilution by the refrigerant.

Methylene Chloride (Carrene-1):

Methylene chloride is another halogenated hydrocarbon refrigerant frequently used for systems equipped with centrifugal or rotary type compressors. The reaction and miscibility of this refrigerant with lubricating oil are very similar to those of the Freon group: therefore, recommendations for lubricating oils should be guided by the same considerations as for Freon-refrigerated systems.

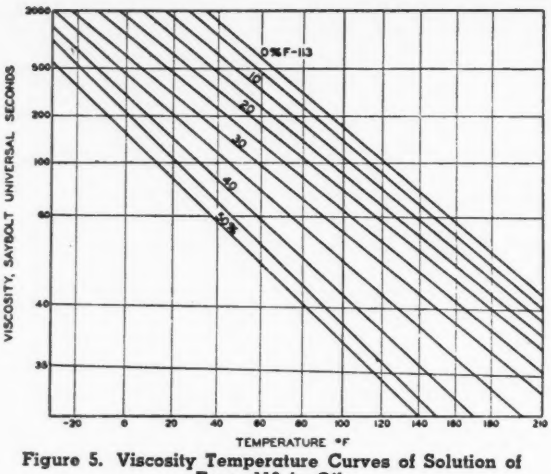


Figure 5. Viscosity Temperature Curves of Solution of Freon-113 in Oil.

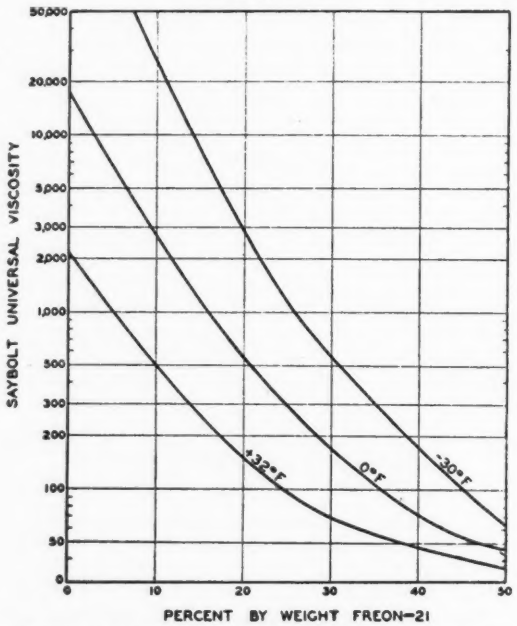


Figure 6. Viscosity of Oil with Various Percentages of Freon-21.

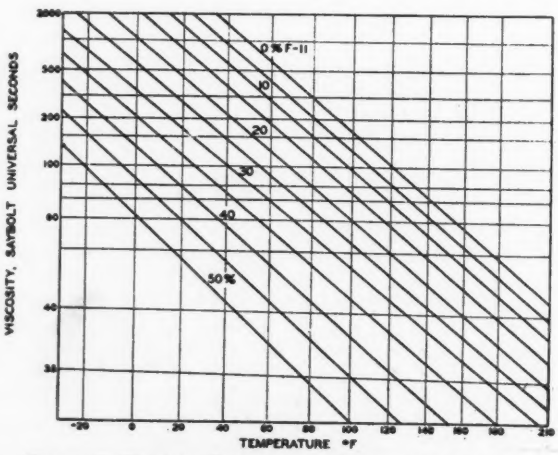


Figure 7. Viscosity Temperature Curves of Solution of Freon-11 in Oil.

Methyl Chloride (CH_3Cl):

Methyl Chloride gas dissolves in oil at temperatures and pressures encountered in refrigerating systems, in somewhat limited proportions. It does not react chemically with well-refined lubricating oils.

X. Miscellaneous Discussions

(a) Naphthene Base Oils vs. Paraffin Base Oils:

There has always been considerable discussion as to the relative merits of oils produced from naphthene and paraffin base oils. Obviously, all oils have much in common. Years of practical service experience have proven that Gulf Coast naphthenic oils possess better qualification for refrigeration compressor lubrication service than paraffinic or mixed base oils, i.e., (1) they have much lower pour points, which is considered most favorable, (2) they form much less carbonaceous deposits during service, the carbon being of the soft "sooty" type that does not form hard crust-like deposits difficult to remove which is also considered as favorable, (3) they throw out much less wax at low temperatures with miscible refrigerants, (4) they are somewhat more susceptible to change in viscosity with change in temperature which is considered by some as unfavorable. This difference in the case of properly selected oils is not of a magnitude which has any significant practical importance.

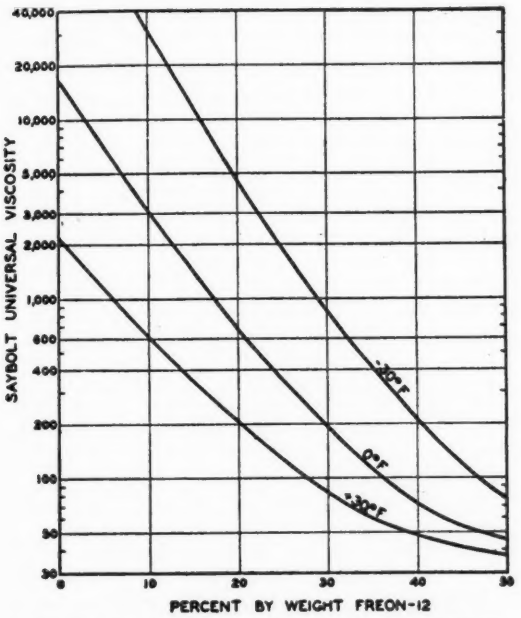


Figure 8. Viscosity of Oil with Various Percentages of Freon-12.

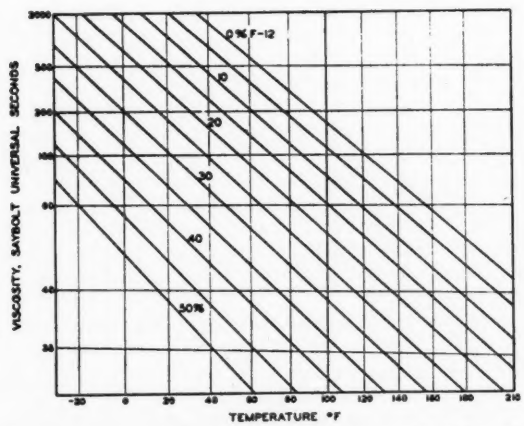


Figure 9. Viscosity Temperature Curves of Solution of Freon-12 in Oil.

(b) Pale Oils vs. White Oils:

The relative merits of Pale Oils (medium refined) and White Oils (highly refined) for refrigerator lubrication has been a subject of considerable discussion. The following general comparisons can be made with the realization that the type of equipment and the degree of exposure of the oil provides a variable basis for evaluation. White oils have the property of initially resisting the formation of sludges on oxidation, but this early resistance is followed by extremely rapid rate of general deterioration which results in shorter life in service. Instead of forming sludges, the deterioration goes in the direction of resin and acid formation. Pale oils have less resistance to sludge formation but have a very much slower rate of general deterioration. Resin and acid formation in Pale Oils is relatively much lower than for a White Oil and the acids so formed are distinctly less corrosive. Both types are susceptible to improvement by additives. The overall stability for long-term usage is in favor of a Pale Oil. It is interesting to note that at least 85% of all refrigerator oils used are of the pale or medium refined grade.

(c) Uninhibited Oils vs Inhibited Oils:

The last several years has seen a very considerable interest and increase in the use of additives. The selection of an oxidation inhibitor, for example, requires a careful balance of type oil, its refinement and the expected service conditions. This can result in the selection of different inhibitors for use in the same base oil when the service conditions are sufficiently different. Inhibitors can control corrosion, sludging, acid formation and viscosity increase. While any one oxidation inhibitor may have a beneficial effect in a number of uses, the optimum results for any service can be had only by careful selection of available additives. Inhibitors have variable effects, such as slowing the rate of deterioration down to a very low level in one instance, or apparently stopping all deterioration, to all practical purposes, for a very considerable period of time. While inhibitors do have somewhat different effects on the various by-products of deterioration of an oil, they often affect the various by-products to a common degree. This subject is receiving attention in the field of refrigeration compressor lubricants and future developments may well see the use of inhibited oils in the large or commercial and industrial type units.

(d) Narrow Cuts vs. Wide Cuts:

The question has frequently been raised as to the significance of boiling point range in lubricating oils. For practically all purposes, the advice that "moderation in all things is worth while" can be applied. In other words, the two extremes should be avoided, a too narrow cut is impractical and a too wide cut is undesirable because of the presence of extremely light and heavy ends.

(e) Oil-Refrigerant Relationships:

In the days when commercially used refrigerants had little or no solubility effect on the oils used, it was not necessary to be concerned about such things as viscosity dilution, wax formation, etc. However, with the

now prevalent use of halogenated refrigerants, it is pertinent that we know more about the oil-refrigerant relationships, such as miscibility, solubility in both liquid and vapor phases, emulsibility, etc., and the effect or function of temperature and pressure on these relationships. Some considerable work has been done along these lines by both refrigerant and oil manufacturers, so that today information is readily available on this subject.

(f) Evaluation Tests:

Many so-called short or laboratory tests have been employed in attempts to evaluate oils prior to their actual use in compressors, etc. Each of these tests has had a main and common point in view—the stability of oil in actual service, or in other words, a pre-service determination of changes in oil characteristics that would occur in actual service. Exclusive of other points of unsuitability, most of these tests were deficient in that the factor of time was entirely inadequate, a condition that led to many erroneous, and in some cases disasterous, conclusions on such items as effect of degree of refining, inhibitors, copper plating, etc. By establishing proper time factors for these various tests, it has been possible to obtain test results that can be safely and soundly used to evaluate oils, at least with considerable certainty as to lack of suitability and in most cases as to specific suitability in various types of service.

(g) Catalytic Effect of Metals:

It is well known that when an oil is exposed to oxidizing conditions such as air, water or high temperature, the presence of certain metals will bring about increased rate of deterioration. Copper is the worst offender, followed by lead and iron. Under certain conditions tin and zinc may actually perform as retarders rather than catalysts. Obviously then, such copper alloys as brass and bronze will also be undesirable. The finely ground metals are most active, as well as the oxides and hydroxides, again particularly of copper and lead.

(h) Moisture Content:

The presence of water or moisture in any form within a refrigerating system is acknowledged to be undesirable. Oils have often been under suspicion as the source of sufficient moisture to bring about undesirable reactions in these systems. Actually, mineral oils are somewhat hygroscopic, and therefore a reasonable degree of care must be exercised where the presence of a usually insignificant amount of moisture assumes some significance.

As ordinarily prepared, packaged, and shipped, refrigerator oils contain such low content of moisture that they have a dielectric strength value well in excess of 25,000 volts. Unless the system itself contains further amounts of water, such as in air space and metal surfaces, or refrigerant, the evidently slight trace of moisture in the oil is of no significance. With the present care exercised in completely dehydrating all systems initially as well as introducing drying cartridges, troubles due to moisture have largely disappeared. Clogging due to ice, corrosion, and copper plating are now very largely matters of the past, or at worst, of rather infrequent occurrence.

In recent months some claims have been made regarding the merits of certain addition agents, in that they completely nullified the deleterious effects of moisture. Frankly, the chemical nature and behavior of these agents do not inspire much enthusiasm for their extensive use. Careful attention to dehydrating procedures is thought to be much more reliable and desirable.

(i) Copper Solubility and Copper Plating:

In refrigerating units, with halogenated refrigerants, in which considerable amounts of copper are used in coils, tubing, electric motors, etc., an "electrolytic" action may take place (in presence of moisture) and metallic copper will be deposited on cylinder walls, pistons, valves, bearings, etc., and cause difficulties in the operation of the compressors. Lubricating oils and refrigerants were formerly blamed as the source of this trouble. Most extensive investigations in refinery laboratories were carried out in order to ascertain if the lubricating oil contributed to these troubles.

Some people advocated the use of very highly refined white oils to stop this "copper plating." Special coatings applied by the manufacturers in some cases to prevent "copper plating" did not solve the problem, because frequently they were attacked by the refrigerant or by over-refined oils; cracks developed in the coating, exposing the copper to the electrolytic action in the system.

Results of careful and thorough investigation have proven that merely using White Oils in such cases will not prevent "copper plating." Actually, these too highly refined oils are likely to develop corrosive acids and increase the copper solubility and thereby tend to promote copper plating, if the other conditions necessary to induce and contribute to this chemical and electrolytic process are present. It is known that copper dissolves slightly in oil but it is also an established fact that excessive moisture must be present to initiate this process before metallic copper is separated and deposited in the system. This has been very forcibly proven, because as soon as efficient dehydrating cartridges were introduced in such refrigerating systems and properly refined Pale Oils used for lubrication, the difficulties previously caused by copper plating practically disappeared.

Manufacturers of sealed units cooperated in this endeavor and are now carefully drying out the system, frequently by "baking" it, before charging refrigerant and lubricating oil. The producers of refrigerants, as well as oil refiners, use every care and precaution to keep moisture in their products at an absolute minimum.

(j) Wax Content in Oils:

When the matter of copper plating became outmoded, a new topic of discussion arose in the refrigerating industry—the formation of wax in refrigeration systems. And again, true to form, the medal of suspicion was pinned on the lubricating oil used. No mention was made, at least in defense of oils, that certain refrigerants have the characteristic of acting as a solvent dewaxing agent on oil and causing the inherently present waxy compounds to separate as crystalline or amorphous waxes at low temperatures. Nevertheless, this does happen to be the case, and due to changes that the refrigerating industry had of its own volition introduced, the lubricating oils were unwittingly placed in an unfavorable light.

Going to lower and lower temperatures has resulted in "plating out" of oil of high viscosity, resulting in excessive reduction of flow space in capillary tubes, even to the point of actual stoppage.

There has been no fundamental change in the chemical and physical characteristics of available oils in recent years. There have always been certain quan-

tities of waxy materials in oils, varying in degree with type and treatment.

In the case of wax formation, new changes, such as expansion valves with right-angle flow line and smaller diameter capillary tubing, welding together of hot and cold lines, etc., as well as new refrigerants, have brought about difficulties that did not exist before. The new refrigerants cause greater separation of waxy material on low temperature side of the system. These solids are carried along in the liquid stream through the expansion valve, and formerly passed on through in a straight-line flow, but now they impinge on side wall due to right angle turn and build up a heavy layer of wax. Periodically the wax breaks off in large chunks and passes on into the capillary tubes which may be clogged up more or less permanently depending on the type of wax. The soft amorphous wax obtained from some oils, clogs tubing temporarily until pressure builds up sufficiently to push it through ,but with the hard, crystalline waxes increasing pressure merely tightens the wax plug and flow through the tubing is completely stopped.

Wax in oils is ordinarily determined by the methyl-ethyl-ketone (MEK) test, the amount of wax separated out at –10 F being specified. For many systems a low wax content at –10 F is quite satisfactory since this is lower than minimum operating temperatures. Some oil producers took advantage of this test condition and so treated oils as to get a low MEK value at –10 F. However, on extending the test temperature down to –35 F, a temperature now frequently encountered in practice, these specially dewaxed oils yielded appreciable quantities of wax between –10 F and –35 F, so that any decisions based on wax content at –10 F might later lead to unexpected difficulties.

On this count again, the already well established grades of oil are demonstrating their reliability. They show only the normal increase in wax content as temperature is lowered and their subsequent behavior can thus be pre-determined with some degree of certainty. In fact, recent improvements have eliminated all separation to temperature as low as –90 F. Some comparative tests follow:

Sample	MEK (—10F)	MEK (—35F)	Sample	MEK (—10F)	MEK (—35F)
A	Neut.	0.01	I (w)	Tr	0.29
B	0.02	0.10	J (w)	0.23	0.59
C	0.21	0.23	K	Tr	0.04
D	0.30	0.41	L	0.04	0.15
E	0.04	0.14	M	0.05	0.17
F (w)	0.39	0.42	N (w)	0.15	0.50
G	0.73	1.65	O (w)	0.02	0.03
H (w)	0.56	0.59			

It is of considerable interest to note neutralization number on these same oils before and after Rogers Oxidation Test, as follows:

Sample	Neut. No. Before	Neut. No. After	Sample	Neut. No. Before	Neut. No. After
A	Neut.	0.15	I (w)	Neut.	0.04
B	0.01	0.15	J (w)	Neut.	0.10
C	Neut.	Neut.	K	Neut.	Neut.
D	Neut.	0.03	L	Neut.	0.05
E	0.01	0.15	M	Neut.	0.02
F (w)	Neut.	15.1	N (w)	Neut.	28.5
G	Neut.	0.03	O (w)	Neut.	Neut.
H (w)	Neut.	37.8			

The development of acidity in White Oils is quite apparent.

(k) Effect of Rust-Proofing Processes:

A more recent subject of discussion in which oil has been concerned, has to do with the use of parts that have been surface-treated to prevent corrosion. Some suspicion arose as to the effect on oil by the surface-coatings applied in accordance with several proprietary rust-proofing processes. The results of investigation indicate that some of the surface coatings promote deterioration of certain oils and in some cases show inhibitive effects.

XI. Lubrication

(a) Lubricating Systems:

There are two general types of lubricating systems designed to furnish the most efficient lubrication for refrigerator compressors:

(1) In open type compressors (with open crankcases), the oil is withdrawn from the system. They are usually large horizontal industrial compressors used in ice plants and in industrial processes and are frequently equipped with separate systems for the lubrication of cylinders and bearings.

In "open crankcase type" compressors operating in a horizontal position, lubrication is provided by two systems:

1. Piston and piston rod lubrication is provided by a pressure system which injects predetermined amounts of oil to stuffing box gland and cylinder.

2. Bearing lubrication is provided by lubricating systems such as force feed, gravity or splash.

Well designed systems are provided with an oil separator on the discharge line which separates the oil entrained in the high pressure gas as it travels to the condenser. If entrained oil in the high pressure gas is carried into the condenser it will adhere to the walls, thereby reducing the efficiency of the condenser.

A lighter oil is used for cylinders than for the lubrication of bearings, where the oil is exposed to greater pressure.

The oil for cylinder lubrication of refrigerator compressors is not consumed to any considerable degree and remains in the cylinders a long time; therefore, any excess of oil should be avoided, otherwise it will form a coating in the expansion coils and decrease the efficiency of the system.

(2) In closed type compressors, the same oil serves for the lubrication of bearings and cylinders and remains in the system. A heavier grade of refrigerating oil must be used in such machines.

All industrial compressors, especially those of the older type which have been in service for some length of time should be carefully inspected for worn parts and, if advisable, heavier oils should be recommended in such cases in order to avoid an excess of oil from being pumped into the expansion coils and mixed with the refrigerant vapors. This entrained oil can be removed by any suitable oil separator.

(b) Lubrication of Industrial Compressors:

In large vertical or horizontal refrigerator compressors "pressure lubrication" is extensively used.

"Splash lubrication" is better adapted to vertical compressors.

Pressure lubrication permits more accurate control of the amount of oil delivered to cylinder walls and to bearings, but requires considerable piping and frequent attention by the operator, who has to refill the reservoir and regulate the flow of oil.

(1) Mechanical Force Feed Lubricators

Cylinders and bearings are extensively lubricated by means of mechanical lubricators.

A mechanical lubricator consists of a small rectangular tank, divided into several compartments, located at a level above the parts to be lubricated. It is fitted with a plunger mechanism, operated from cams or levers which are connected with some rotating part of the compressor. When the compressor is in operation, the plungers pump the oil through check valves into feed lines to certain points in the cylinder walls; to bearings and to all other moving parts. The amount of oil can be regulated by adjusting the plunger stroke.

Frequently, different grades of oil are contained in the compartments of the lubricator for lubricating of compressor cylinders.

Force feed lubricators for refrigerator compressors should not be open to the air, in order to prevent moisture from entering the system and freezing at the low temperatures encountered. On the other hand they should meter out the lubricant and deliver it regularly to all points to be lubricated in minute predetermined quantities only. The amount supplied by each unit can be seen in the sight-glass. Any excess of oil might tend to cause carbonization at some of the "hot spots" frequently occurring in large industrial compressors. Care must be taken that the oil feed lines are filled before operation of the compressor begins. For this purpose a manual handcrank is usually part of the lubricator, which can also be operated when it is found necessary to increase momentarily the supply of oil to certain points.

In large horizontal and vertical compressors with crossheads, internal parts, cylinders, piston and rods are lubricated by mechanical lubricators with low pour test refrigerating oils, while external parts such as bearings, pins, cross-head guides, governors, etc., are serviced with machine oils by an independent gravity or pressure circulating system.

In the smaller horizontal compressors, oil is introduced at the top-center of the cylinder.

In double-acting compressors the oil is introduced in the middle of the cylinder and the piston covers the oil parts during its travel. Automatic valves keep the oil in the feed lines by checking back pressure during the compression stroke.

In some systems the "injection method" is used. The oil is injected into the suction line and a spray of oil is carried into the cylinders by the flow of gas and forms a film of oil over all exposed surfaces. This method is rather wasteful and there is always danger that excess oil will cause sticky valves.

In practically all compression machines with reciprocating parts, the oil serves also as a seal in the stuffing boxes. Hot ammonia gas has a very bad effect on the packing of stuffing boxes and sufficient lubricating oil with a good flash point should be used to prevent overheating.

Piston rods must be properly lubricated to prevent wear and leakage of gas. Lubrication is accomplished in a stuffing box with oil seal. Generally an "oil lantern" is located between two sets of packing; they are hollow spaces surrounding the rod into which the oil is pumped through an opening from a reservoir. From the lantern the oil flows through the packing; another opening from the lantern is connected with the suction side of the compressor and any gas which leaks by the packing rings is returned to the cylinders. A well lubricated piston rod is bright and smooth and covered with a thin film of oil.

In some types of double acting compressors the "oil lantern" serves also to feed the lubricating oil to the compressor cylinder. The oil penetrates past the piston rod packing, at the same time protecting the packing from the bad effects of the ammonia.

(2) Oil Separators

Most industrial refrigerating systems are equipped with oil separators to aid the separation of the oil from the refrigerant, or oil interceptors located between discharge valve and close to the condenser. They are generally cylindrical tanks, with baffles and a sight gauge glass to indicate the level of the oil. Any particles of oil mixed with the gas after it has left the compressor, are precipitated in the separator. If the refrigerant is much lighter than the oil and not miscible with it, the oil will separate by gravity in the receiver.

(3) Lubricating Systems

Every compressor manufacturer has his own system of lubrication or a combination of systems, which serves his equipment best. For instance, we find in some older types of steam driven horizontal refrigerator compressors, a splash system for cylinder walls and piston lubrication and oscillating mechanical lubricators for lubrication of external parts. In some of the latest models, oil is pumped from the crankcase into a sump and from there circulated under pressure and returned through filters to the crankcase; a mechanical lubricator forces engine oil to bearings and cylinders and in a third system lubricating oil is also used to regulate the operations of the governors with automatic cut-off. An oil pump, chain-driven from the main shaft, takes suction from the crankcase and forces oil under pressure, acting against the governor plunger. The oil pressure is increased or decreased by the variation in the steam pressure and speed of the compressor, causing a movement of the rack and weight which is part of the governor, and by means of a diaphragm-operated valve which by-passes part of the oil flow. The change in oil pressure thus effected controls the speed of the unit according to load demand.

Another modification of force-feed lubrication on large industrial compressors embodies a chain-driven gear pump which furnishes positive pressure lubrication. Oil from the reservoir enters the pump intake through a strainer and is discharged from the pump to a screen type filter which can be cleaned while the compressor is operating. Before being distributed to the bearings, the oil is passed through an oil cooler, assuring cool, clean oil for all bearings. The oil is distributed through drilled passages or oil lines to the bearings, cross-head pins, guides, etc. Excess oil from the pump is by-passed to the main reservoir or to the oil sump by a relief valve.

Automatic devices stop the compressor in case of oil pressure failure from any cause.

(4) New Compressors

A new compressor requires more oil for cylinders and bearings until it is well "broken in" and the surfaces requiring lubrication have become smooth and coated with an oil film. It is advisable to drain all the oil and clean the crankcase carefully of all dirt, metallic particles, lint, etc., and refill it with clean, fresh oil. After the compressor has been started again and is running,

the oil level in the reservoir should be carefully watched and oil added until the oil level is several inches above the intake pipe; this is marked as the "low level" when the compressor is running. If the compressor is shut down and the oil has drained back into the reservoir, the oil level is marked as "low level—idle" and after adding oil another level is established for "high level—idle." After the compressor is started again the resulting oil level is marked as "high level—running."

Frequency of change of oil depends on operating conditions and time-efficiency of operation. Most manufacturers of large heavy-duty compressors recommend oil change at least every ninety days.

Instruction books furnished by each manufacturer should be studied and followed carefully by the lubricating and operating engineer.

(c) Splash Lubrication:

Smaller industrial and commercial vertical refrigerator compressors have enclosed crankcases. Cylinders, pistons and bearings are lubricated by a splash or circulating system. In the "splash" system the refrigerating oil (for cylinders and bearings) is stored in the crankcase at such a level that the crank dips into the oil at each revolution and splashes a sufficient amount of oil spray to the cylinder walls, pistons, etc. An excess of oil in the crankcase would cause violent agitation or churning of the oil by the crank, which would prevent precipitation of any foreign matter which might be in the system and could have a detrimental effect on the lubricating oil. Such excess oil might also enter into the condensing and evaporating system and cause operating difficulties of the entire refrigerating machinery.

(d) Lubrication of Domestic and Smaller Commercial Units (Electric Refrigerators):

(1) During the earlier stages of development of these units "splash lubrication" was the system most commonly used. Some trouble occurred due to "foaming" in reciprocating compressors installed in these smaller units.

Foaming is invariably caused at the start of the cycle when return gas has been absorbed in the oil and is suddenly released as the compressor starts lowering the pressure in the crankcase. There is always danger that the foam topping the oil level in the reservoir might cover the suction valve and be carried over to the high side of the compressor with the refrigerant and cause serious difficulties.

This experience led to efforts to develop several systems of "pressure lubrication" in order to obtain positive circulation of the oil through the compressor, which would practically eliminate "foaming."

One type of pressure lubrication is very similar to the lubrication of an automotive engine by an immersed gear pump in the crankcase. The pump always has positive suction, being located below the oil level in the reservoir or crankcase, and discharges the oil under pressure (regulated by the speed of the gears) through small feed lines to the cylinder walls, or through drilled passages to the bearings and other parts to be lubricated. After forming the required protective film, the surplus oil returns to the crankcase by gravity and is recirculated.

Another type of pressure lubrication makes use of a "rotary" pump. Two blades moving in a slotted rotor perform the "pumping" of the oil which is carried in a reservoir in the base of the refrigerating unit. The oil is lifted from the reservoir through drilled passages in the motor shaft and distributed to the bearings and to the cylinder walls.

In some units part of the oil is used to cool the windings of the motor before returning to the sump.

Another system applies "splash lubrication" to lubricate the cylinder walls, and a reciprocating pump with a single oscillating cylinder operated from an eccentric on the end of the crankshaft, for the lubrication of main bearings and through drilled passage ways and tubing to all other bearings.

As stated previously, lubrication is provided for when the manufacturer charges the unit with the refrigerant and oil before it leaves the factory. Both are expected to last and give satisfactory service for years.

If any repair or maintenance service is required, the manufacturer or dealer attends to it. Both of them know the best type of refrigerating oil for their particular product and purchase it directly from the refiner and charge it into the unit after the mechanical repair work is completed.

In most such cases a "dehydrating cartridge" is inserted in the system and left there for two or three days, to insure a perfectly "dry" unit; then the cartridge is discarded and the unit placed again in regular operation.

(2) Dryers or cartridge dehydrators are tubular appliances, containing moisture-absorbing material such as silica gel, activated alumina, drierite (porous anhydrous calcium sulfate), calcium oxide or anhydrous calcium chloride, in a sack or in a dispersion tube. They are manufactured with capped or flanged end shells which can be inserted into the liquid-circulating line.

Refrigerator manufacturers insert them in commercial and sealed units before they go on the market, to remove all moisture from the system. The liquid refrigerant and the oil circulate through the cartridge for two or three days, then the cartridge is disconnected.

In case moisture has entered such refrigerating units, during service and during regular overhaul and inspection periods in railroad shops or in bus and truck garages, service men or experienced mechanics also apply dehydrators to remove any moisture from the system.

(e) Lubrication of Bearings:

On large heavy-duty refrigerator compressors a gear pump or motor driven centrifugal pump forces oil to a header supplying oil to the bearings.

"Floor lubrication" (splash system) is also used. When the compressor is in operation the oil is struck by the crank disc and thrown in heavy clouds to all parts of the interior of the crankcase. The crank and crosshead bearings are constantly flooded with oil and a portion of the oil drains to the main bearings. All oil drains back to the reservoir and is used over again. Openings in the oil shields facilitate inspection of the lubricating system while the compressor is in operation. Through a drain pipe at the bottom of the oil reservoir the crankcase oil can be drawn out.

A gravity circulating system generally has an oil reservoir at a higher level from which the oil flows by gravity to the different bearings; from there it drains to a lower reservoir and is pumped back through a screen or filter (to remove any impurities) to the upper

reservoir and used over again. If the oil is contaminated with water it should go to a separator before it is pumped back to the reservoir.

In the force feed lubricating system, oil is pumped to the bearings from a central reservoir and it drains back by gravity to the reservoir. The same precaution for cleansing the oil should be taken as in the gravity system.

Bearings are frequently lubricated also by ring and chain oilers. The lubricating oil acts also as a cooling medium because it removes part of the frictional heat developed in the bearing.

A "ring oiler" consists of a machined ring of a larger diameter than the journal; the ring rotates with the journal and dips into an oil reservoir, located beneath it, picks up the oil and carries it up to the bearing surface, which generally has "oil grooves" for the distribution of the oil over the entire surface. The excess oil is removed by a wiper or scraper or is thrown on the housing and runs down on the journal and back into the reservoir. The level in the oil reservoir must be maintained sufficiently high so that the ring always dips into the oil. Ring oilers are used for the lubrication of outboard crankshaft bearings of industrial reciprocating compressors and of rotor bearings of centrifugal compressors.

The oil acts also as a "shaftseal" (where the shaft passes through the casing) in combination with the lapped metallic seals customary in centrifual compressors. This arrangement prevents air from entering the system and the loss of refrigerant into the atmosphere.

In the centrifugal type design, such as Carrier Corporation units, oil is supplied to the seal by pressure during operation and the metal seal faces are separated by oil pressure; when the compressor is not operating a metal-to-metal seal is made under oil.

"Chain oilers" operate on the same principle as the ring oilers; an endless chain rides on the journal, dips into the oil in the reservoir and brings it to the bearing surface.

Outboard bearings are also lubricated with "sight-feed oilers." They consist of a cylindrical cup filled with lubricating oil, which flows through a tube into a hole in the bearing. A glass is inserted in the oil tube so that the flow of oil is visible and can be regulated by a needle valve inserted into the oil tube.

(f) Lubrication of Air Conditioning Equipment:

(1) Unit Systems

The lubrication of small "unit-type" air conditioning equipment using mechanical lubrication is very similar to that of the sealed domestic refrigerating unit; it is expected to give service during the life of the unit. The original charge of refrigerating oil and any necessary service is, and should be, taken care of by the manufacturer or dealer from whom the equipment was purchased.

In railroad, trucking, bus and airplane service, which places a much heavier load and more severe service conditions on these small units, regular inspection and overhaul periods are customary while such carriers are in the shops for inspection and repair. Skillful mechanics, generally factory trained, attend to these air conditioning units. Refrigerator oils specified for the lubrication of these units are purchased in sealed containers and kept in stock by the operators.

(2) Commercial Units

In commercial units of small tonnage, "splash-lubrication" is mostly used for the enclosed type vertical reciprocating compressor.

(3) Centralized Systems

In large "centralized systems" (theatres, hotels, department stores, hospitals, industrial plants, office buildings, etc.) "pressure lubrication" is used in the large type horizontal and vertical compressors for the lubrication of cylinders and piston rods, etc. In some designs an overflow pipe from the stuffing-box oil lantern carries the oil to the suction line and the oil is delivered to the cylinder with the refrigerant.

Force-feed lubricators are also used advantageously. Some designs of compressors in this service contain an enclosed type of force feed pump located on the bottom of the crankcase and driven from the main shaft. Such a pump always has positive suction and delivers oil through feed lines to all moving parts under positive pressure.

(4) Motor and Fan Lubrication

The bearings of motors and fans—which are essential for the proper distribution of the cooled air—are mostly of the anti-friction type; their lubrication is identical with such bearings in industrial use. The lubricant must protect the highly polished surfaces from pitting and corrosion; it must seal the housing against foreign matter (dirt and water), and must support sliding and rolling contact within the housing. Oil or grease serve as lubricant. The recommendations of the manufacturer of such bearings, which are based on the service, operating conditions, speed and temperature, should be followed.

(5) Air Filters

Before air is conditioned for circulation, dust and dirt should be removed. Various types of filters and cleaners which have to clean the air thoroughly without offering too much resistance to the flow of air, are used for this service. Some types of these filters—in large air conditioning systems—employ a viscous oil film to hold dust and dirt; the coating which gradually accumulates and would render the filters inefficient is removed periodically and the cleaned filter dipped in oil, or the oil is sprayed on the filter medium. Self-cleaning automatic filters are on the market; the unit-screen panels rotate continually through an oil reservoir at the base of the filter and the dirt is washed off and accumulated in a "sludge-pan," from which it can be removed. The oil in the reservoir is changed periodically, whenever it becomes too saturated with dirt.

Other methods of air cleaning use special composition filters (for small units), air washers, centrifugal filters, etc.

Well-refined refrigerator compressor oils for low temperature operation and good grade of light engine oils for warm air are recommended by the filter manufacturers. These oils must be practically odorless so as not to impregnate the filtered air with a "petroleum odor," which might be objectionable to the public in theatres, office buildings, hospitals, etc.

(g) Break-in Oil:

It is customary to "break-in" new units with a refrigeration oil of lighter viscosity than is used in regular operation, this oil of lighter viscosity being known as "break-in" oil.

★ *THREE IMPORTANT DAYS ON THE 1948 CALENDAR* ★

APRIL 19-20-21

3rd ANNUAL CONVENTION

A.S.L.E.

THE AMERICAN SOCIETY OF LUBRICATION ENGINEERS

HOTEL STATLER, BUFFALO, N. Y.

A THREE DAY PROGRAM OF INTEREST TO EVERYONE IN THE FIELD OF LUBRICATION

Technical and Practical Topics covering Lubricants and their application will be presented by

RECOGNIZED AUTHORITIES

Members and Guests will have the opportunity to view the Products of Key Manufacturers of

INDUSTRIAL LUBRICANTS AND LUBRICATION DEVICES

CUTTING FLUIDS TESTING AND LABORATORY EQUIPMENT

LATEST METHODS OF HANDLING AND CONVEYING LUBRICANTS

NEW AND IMPROVED METHODS OF APPLICATION

For the First Time assembled in an Exclusive

LUBRICATION EXHIBIT

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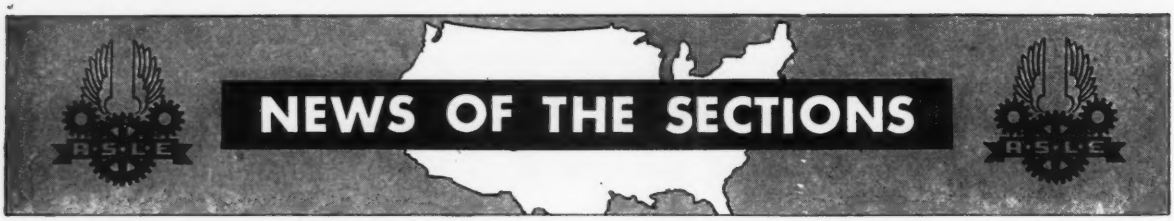


CLEVELAND-YOUNGSTOWN

This section started off their fall program with a Clambake at Astorhurst Villa, Southeast of Cleveland, on Thursday, October 2. Members and guests attending pronounced the afternoon and evening a huge success.

On October 28 the regular dinner meeting was held in Cleveland Engineering Society rooms and was well attended. Mr. Frank Ross, Section Lubrication Sales Manager of the E. F. Houghton & Co., gave his outstanding paper in "Confused Lubrication" covering the difficulties encountered in machine tool manufacturer's recommendations for lubricants. Mr. Ross has been a familiar figure in several sections in the country where this same talk has been enjoyed. When interviewed at the Machine Tool Show in Chicago in September, Mr. Ross informed your reporter that he had in preparation another talk along somewhat similar lines. This new paper we are sure will be received with much interest.

PHILADELPHIA

A dinner meeting was held September 18 at the Broadwood Hotel, Philadelphia. Mr. C. L. Pope of Eastman Kodak Company, gave an interesting paper on "Lubrication Engineering in General" followed by an hour of discussion. Dr. Dudley Fuller brought the section members and guests up to date on the activities of the Society from a National standpoint.

NORTHERN CALIFORNIA

Following the usual dinner at the Officers' Club, Treasure Island, San Francisco, California, on Nov. 6, the regular technical session was held. Speaker of the evening was Mr. Wilbur Deutsch, who gave a very interesting and descriptive paper on the Alemite, Farval and Trabon centralized lubricating systems, pointing out the construction and operating features of each. The paper was followed by prepared discussion and questions which were answered by representatives of the three companies who displayed working models of their equipment. The section expressed appreciation for the services that Mr. Deutsch had rendered as its first chairman and its regret for his transfer to the Cleveland area. Mr. Harvey G. Isbell, Chief Chemist at the U. S. Navy Yard, Mare Island, California, will serve as Chairman for the balance of the term.

BUFFALO

The regular October meeting of the Section was held at the Pinetree Inn at Rochester, N. Y. Many members and guests including nineteen of our Canadian neighbors, assembled to hear Dr. William H. Millett of the Linde Air Products Co., who spoke on "Industrial Uses of Synthetic Lubricants." Dr. Millett's talk was followed by a very lively discussion.

Earlier in the day, National Secretary, W. F. Leonard, met with Chairman Peuchen and other members of the Committee, at the Statler Hotel in Buffalo, where arrangements were completed for the exhibition space for the show which will run concurrently with the National meeting in April. The Buffalo Section is making extensive plans for the meeting and looks forward to a large registration.

On November 21, at a meeting at the Royal Connaught Hotel in Hamilton, Ontario, two very interesting talks were given by U. E. Brown, Chief Engineer of the Cable Division of B. Greening Wire Company on "Common Sense of Wire Rope," and Geo. Miller, President of the Battenfeld Grease & Oil Co., presented "Greases" in a very interesting manner. Both papers were followed by lengthy discussion. The Buffalo Section reported a definite gain in members and interest, as is shown by the attendance of 111, at this meeting.

CHICAGO

On November 20th, the regular monthly session of this Section was held at their new meeting place, the Columbia Yacht Club. The first business of the session was the election of two new officers to fill vacancies caused by the resignation of W. F. Leonard, as Chairman and S. A. Hastings, as Secretary. Mr. N. Penfold succeeds Mr. Leonard as Chairman and Mr. Donald Gray takes up his new duties as Secretary of the Section. Mr. Carl Schmitz was elected as Vice-Chairman.

Dr. William Millett was the speaker of the evening and gave a very excellent discussion on the uses of "Ucon Synthetics" in industry. An interesting talk followed the presentation of the paper and many favorable comments were heard on the new meeting place.

PITTSBURGH

The regular monthly meeting was held at Stouffer's Restaurant on November 21st. The Membership Committee reported that their membership had increased to 106 in this section, which is a gratifying growth.

Nominations were made for the officers for the coming year. The

committee will report and the vote will be taken at the December meeting. Mr. L. J. Suelzer of Bowser, Inc., gave an interesting talk on lubricating oil circulating systems followed by a period of fifteen minutes of questions from the floor. Mr. Walter Ewbank, Chief Research Engineer of Briggs Filtration Company gave a talk on oil filtration, with a discussion following. Both speakers covered their field very thoroughly and clearly. The talks were well received by the members, and the discussion continued until after 10 p.m.

DAYTON

On November 24th a continuation of the past meeting of this section was held under the title "Information Please." Questions and answers were used, patterned after the same type of meetings originated in Milwaukee last year. Such meetings have been a great success and bring out the many phases of lubrication. This type of meeting proved so popular in October that by special request it was continued. There will be no meeting of the section in December, but on January 23rd Mr. Jan Kaufmann of the Texas Company will speak on the significance of tests for greases. This section reports a decided increase in membership in the past two months.

MILWAUKEE

Prior to the regular November meeting, the Directors' meeting was held by the section and it was decided to sponsor a series of educational lectures early in 1948. Mr. R. D. Bussard of the Ladish Company was appointed Chairman of the committee to guide this activity. These proceedings were followed by a talk on refrigeration by Mr. E. Koth, Chief Research Engineer of the Vilter Company. On December 17 a joint meeting is planned with the section and the Engineering Society of Milwaukee on the subject of aspects of petroleum economics. Dr. Daniel Barnard, Associate Directortor of Research at Standard Oil Co. (Ind.) will speak. The meeting will be preceded by the usual dinner at 6:00 p.m. at the Engineers' Society Building. The paper will be given at the Public Service Building Auditorium, 231 West Wisconsin Avenue, at 8:00 p.m.

NEW YORK

The first meeting of the 1947 season was held at the Midston House, New York City, on October 2, with 60 members and guests for dinner and 100 at the meeting which followed. The speaker of the evening was Dr. W. E. Campbell of the Bell Laboratories, Murray Hill, N. J. His paper "Lubrication of Communication Equipment" was extremely interesting and educational. This paper dealt with the problems concerning lubrication of this highly specialized equipment and present developments.

Mr. J. Fischer, of the Sperry Gyroscope Company led the discussion. Many additional points were brought out by Mr. Rounds of the Barden Company, Mr. J. J. Scott, of the Bound Brook Oil-less Bearing Co., and other well known engineers.

Meeting adjourned after the speakers for the next meeting were introduced.

DETROIT

The first Fall meeting of the Detroit Section was held at the Engineering Society rooms with a large attendance of members and guests.

Following the regular dinner, Mr. L. A. Danse, Supervisor of Materials and Processes Production Engineering Section of the General Motors Corporation, spoke on "Maintenance" with emphasis on "Lubrication." The program ended with a sound moving picture on the A B C of hand tools. The total attendance was 100.

ST. LOUIS

The first meeting of the season was held at the Gatesworth Hotel, preceded by the usual dinner, with a large number of guests present.

Mr. Alfred Underwood of the General Motors Corporation gave a very interesting talk.

On November 18th at the regular session, Mr. Frank C. Linn of the General Electric Company gave a talk on general lubrication.

Much favorable comment was heard among the members on these two meetings and the section is planning for December 16th a session built around the subject of synthetics, at which Dr. W. H. Millett of the Linde Air Products Division of the Carbon & Carbide Corporation will discuss the subject of Ucon synthetics in industry. Dr. Millett is widely known as a speaker on this subject and has been previously heard in Buffalo and Chicago.

The January meeting will be held on the 20th in the same quarters at which time Mr. John Boyd of the Research Laboratories of the Westinghouse Electric & Manufacturing Company will speak.

INDIANAPOLIS

An informal meeting was held on November 10th at the Lincoln Hotel by a group interested in forming a local section of A.S.L.E. National Secretary W. F. Leonard explained the aims and purposes of the Society. It was unanimously voted to organize, and Mr. J. E. Burns was named as Chairman of the nominating committee, putting the session forward to December 8th. At this meeting a large and enthusiastic group assembled at 8 o'clock at the Oil Club located in the Severin Hotel and elected the following officers for the ensuing year:

Chairman: I. S. Bigger, Socony-Vacuum Co.

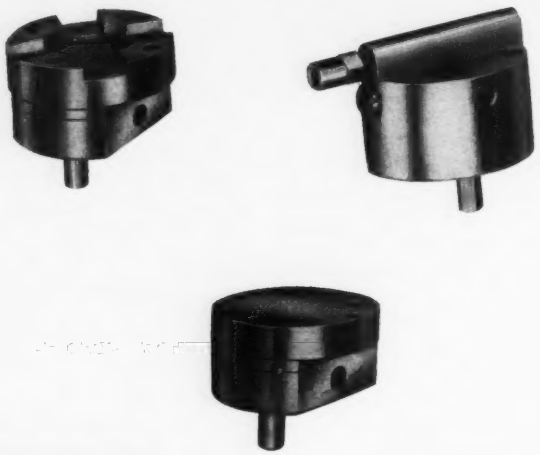
Vice-chairman: Donald H. Wilson, Continental Steel Co.

Secretary-Treasurer: J. E. Burns, Jr., of the Burns Laboratories.

Frank Ross, well-known speaker, of the E. F. Houghton Co., gave an interesting talk on the over-all subject of Plant Lubrication and Lubricants.

The new section will have permanent quarters at the Oil Club and a very successful season is assured. The Officers and Directors of A. S.-L.E. take pleasure in welcoming Indianapolis as its newest Section.

NEW PRODUCTS and EQUIPMENT



New Small Capacity Constant Speed Gear Pump

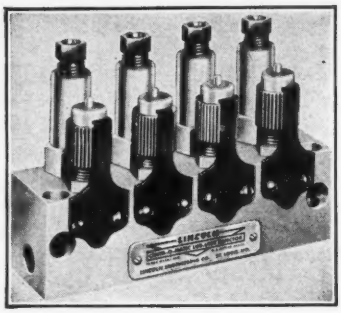
A small capacity unit providing 50 c. c.'s per minute at 100 rpm, a high efficiency unit, the gear maintains a constant speed under high pressure during operation of machine. The three types pictured above, The Universal Gear Pump (upper right) can be mounted in any position, the direction of drive shaft rotation determining the direction of flow. The Reversible Gear Pump (left center) maintains flow in one direction only regardless of change of drive shaft rotation during operation. The Sump Type Gear Pump (lower right) is equipped with an integral fine mesh screen and may be mounted direct in the sump. The manufacturer announces that any one of these three pumps may be used in conjunction with the Bijur System of metered lubrication which is said to provide a correct oil film for each individual bearing automatically. Because of its compactness the pumps are especially adaptable where space limitations exist. For further information write to this Publication, or Bijur Lubricating Corporation, Long Island City 1, New York.

Two New Booklets on Oil Maintenance Equipment Describing the Complete Line of Hilco Oil Reclaimers

Air line oil purifiers and flow oil filters, also covering the Hilco equipment for proper maintenance or lubricating and fuel oil for Diesel locomotives. The Hilliard Corporation, 102 West 4th St., Elmira, N. Y., or this Publication.

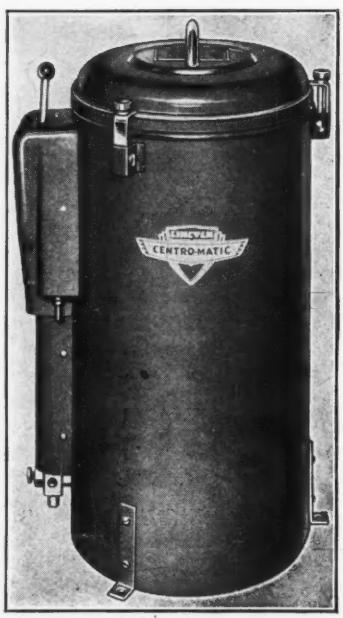
New Fire Fighter with Greater Foam Output and Unique Controls By Kidde & Company, Inc.

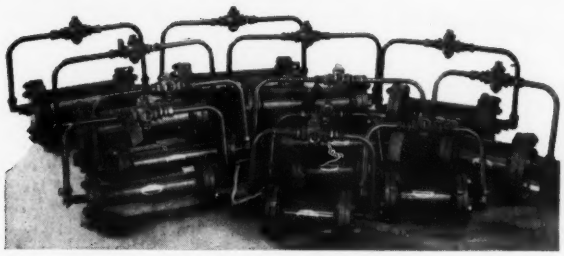
This Company announces a new 40-gallon foam for extinguishing engine, capable of greater foam output with automatic mixing controls, claiming that the new unit is a small fire department. The manufacturer states that the unit will smother both Class A and Class B fires (flammable liquids). All models of the new fire extinguisher carries the approval of the Underwriters' Laboratories and Factory Mutual Laboratories.



A new lubricant injector and lubricant pump as additions to their line of Centro-Matic Centralized Lubricating Systems is announced by Lincoln Engineering Company.

This small compact space saving unit type SL-3 is especially designed for use where mounting space is limited. These injectors have only two moving parts which operate in packings of oil and grease resisting Lin-Pak material. They are available singly or in manifolds of two, three or four injectors. The Model 1825 lubricating pump is an automatic air motor power unit which may be operated to cycle the centro-matic system at predetermined intervals. The pumping unit is totally enclosed and has a pressure ratio of 70 to 1. For further information, write this Publication, or the Lincoln Engineering Company, 5701 Natural Bridge Ave., St. Louis 20, Mo.





News Release — J. N. Fauver Co.

Chevrolet Motor Car Co., Flint, Mich., and Los Angeles Assembly Plant have recently purchased new assembly line lubricant measuring devices for each plant. This new equipment accurately measures the exact amount of lubricant for the transmission, differential, and crank case into each car as it comes down the final assembly line, with variations from 1.5 pints to 14 pints. 13 units are required to accommodate the several car models, and to eliminate delays necessitated by constant adjustments.

Each unit has a cylinder of either 3-inch or 6-inch diameter, with a floating piston. Units are preset by manufacturer for specific amounts of lubricant, but minor adjustments for accuracy are easily made with an adjustment screw on end of cylinder, that controls the length of piston stroke.

Lubricants are supplied to each cylinder from pumps through headers at a line pressure of 40 lbs. A 4-way valve, rope controlled (cylinders are placed 10 ft. above floor) allows lubricant to be supplied alternately from each end of cylinder through a hose, to each car.

This equipment was designed and manufactured by the J. N. Fauver Co., 49 West Hancock, Detroit, Lubrication Engineers, Designers, and Contractors.

Manzel Double Capacity—Changes Name

A manufacturer of lubrication equipment for nearly 50 years Manzel Bros. Company has changed its name to Manzel Incorporated and completed an extensive expansion and modernization program. The floor space of the plant in Babcock Street has been doubled by an addition completed several months ago. A more recent addition increases office area by 150%. This expansion has been made necessary by increased demand for Manzel products and by a recent purchase of the Bowser & Torrington lubricator repair and replacement business from Bowser Incorporated, who have discontinued manufacturing this equipment.

Clean
Continuous
Dependable

LUBRICATION FOR
MOST
INDUSTRIAL NEEDS

Bowser Lubricating Systems are supplied in any capacity for any job requiring circulating, filtered lubricating oil.

Sizes range from self-contained units for individual machines to systems that serve entire plants.

There are no substitutes for the high standards of dependability which have distinguished Bowser Lubricating Systems in many steel mills, paper mills and other industrial plants.

BOWSER, INC. 1358 Creighton Avenue, Fort Wayne 2, Indiana

BOWSER
ESTABLISHED 1885

LIQUID CONTROL SPECIALISTS
Since 1885

Fel-Pro Offers Data on New 1800° "Hi-Temp" Thread Compound

Complete details on the new FEL "HI-TEMP" Thread Compound that is said to prevent freezing and galling of metal surfaces at temperatures as high as 1800°F is now being released by Felt Products Manufacturing Company, Chicago. According to D. B. Grasett, Manager, the new C-5 "HI-TEMP" Compond was developed specifically for high temperatures and high pressure applications, such as furnace tubes, header, studs and plugs, eliminating extensive stud breakage or removals. A copy of the new data sheet, together with a sample can of the material, may be obtained by writing the Felt Products Manufacturing Company, Dept. P-39, 1504 Carroll Avenue, Chicago 7, Ill., or to this Publication.

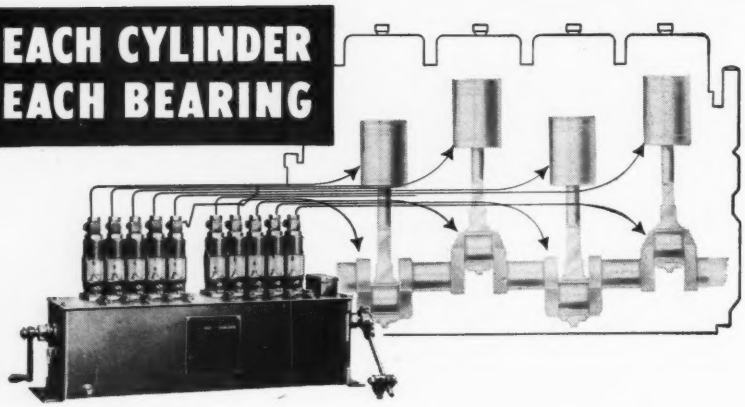
The Just-Rite Manufacturing Company of Chicago has announced the introduction of a new flexible hose attachment for safety cans for storing and pouring flammable liquids, and it is claimed that it is designed to lessen the hazard of storing and dispersing of flammable vapours.

The manufacturer describes the attachment as Model No. 1088, with a 9½" flexible metal hose, a brass cup, and a removable strainer which is held firmly to the can by a steel bracket. When attached, it may be turned in any position and is of sufficient rigidity to remain in that position.

It is recommended for hard-to-reach spots.

For further information write this publication or the Just-Rite Manufacturing Company, 2063 N. Southport Avenue, Chicago.

EACH CYLINDER
EACH BEARING



Individually Lubricated

● By faithfully delivering precise amounts of oil to cylinders, bearings and other points of friction, Manzel Lubricators save engine owners up to 60% in reduced oil consumption and lowered maintenance costs. *You* can insure money saving efficiency by installing Manzel Force Feed Lubricators on present or future equipment. Write for information or advice on any of your problems.

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Brooks Oil Company Announces a New Product

Leadolene "Klingfast" Wire Rope Lubricant. A new member of the Brooks' family of Leadolene "I.P." Indestructible pH-film) is announced by the Brooks Oil Company of Pittsburgh, Cleveland, and Hamilton, Ontario. Of special interest to wire rope manufacturers is the fact that Brooks' Leadolene "Klingfast" is available in colors which will serve to identify, as well as protect their products.

According to the manufacturer "Klingfast" wire rope lubricant possessed the Indestructive pH-film which is characteristic of Brooks Leadolene lubricants and contributes special qualities of importance to successful wire rope lubrication, including unusual resistance to erosion and corrosion even where salt or acidic vapors are present. A new affinity for steel and other metals which develops maximum adhesion, prevents drippage, and yet maintains permanent flexibility. A new resistance to water lubricating oil and grease, scale, dusts, and other prevalent forms of contamination. Successfully withstands temperatures as low as 40°F, as well as unusually high temperatures.

Further information on the new Brooks Leadolene "Klingfast" wire rope lubricant may be oftained from this Publication, or direct from Brooks Oil Company, Pittsburgh 19, Pa.

Carl E. Bolte Joins Battenfeld Grease & Oil Corp.

The Board of Directors of the Battenfeld Grease & Oil Corporation has elected Mr. Carl E. Bolte to the position of Vice-President in charge of sales. The announcement was made December 5 at the corporation's annual recognition dinner by Mr. Arthur J. Daniel, President of the firm.

Mr. Bolte has had a distinguished record of business and civic leadership. Before entering the petroleum industry Mr. Bolte was President and General Manager of the Slater Mill and Elevator Company, Slater, Missouri. Mr. Bolte was President of the Missouri Millers' Association and Director of the Millers' National Federation. He served as Vice President and director of the Rotary International and during the war as director of the Industrial Service Division of the Smaller War Plants Corporation in Washington, D. C. He is a past President of the Missouri State Chamber of Commerce.

Mr. Bolte was appointed Executive Secretary of the National Lubricating Grease Institute on July 1, 1946, a position which he has held since that time. The NLGI Headquarters Staff will carry on the Institute's work until Mr. Bolte's successor is named. His appointment as Vice President of the Battenfield Grease & Oil Corporation becomes effective January 1.

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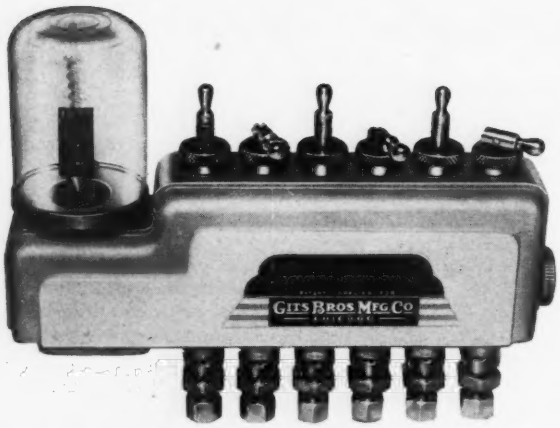

Gits Markets Multiple Oiler

This new product brought out by the Gits Manufacturing Company of Chicago is designed to meet the increasing demand for central point lubrication of multiple remote bearings. It is a centralized unit made up of a transparent reserve oil with a non-spill valve, greatly simplifying refilling in a main reservoir from which copper tubes lead to the various remote oil points. The oil is maintained at an even level insuring a well regulated supply of lubricant to the bearings. Overflow and flooding of bearings is said to be impossible. The unit is completely adjustable, permitting the flow to be turned on or off to each of them. Complete information may be had by writing to this Publication, or direct to the manufacturer, Gits Bros. Manufacturing Company, 1846 So. Kilbourn Ave., Chicago.

Gits Engineers Did It Again!

Manufacturer states,
"Re-lubrication now a matter of seconds"
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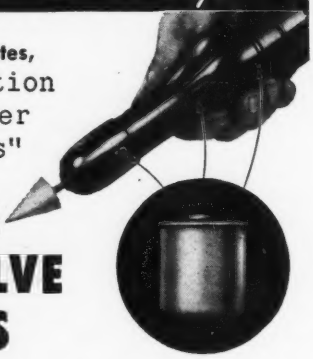
GITS
BALL VALVE OILERS



Precise Products Co., Racine, Wis., acclaims the GITS Ball Valve Oiler, writing: "These efficient self-sealing oilers have facilitated the re-lubrication of our 40,000 RPM electric handtools to such an extent that the failure of ball bearings has been reduced to a negligible number. In our former model . . . handtool this operation required more than fifteen minutes of a skilled mechanic's time."

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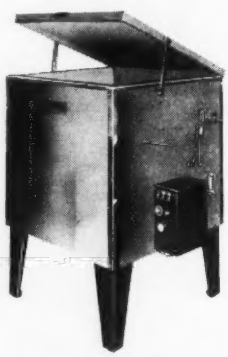
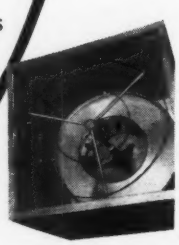
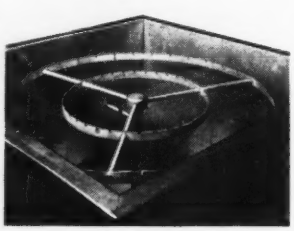




View of rotating stage showing condensate pan and air disperser.



View showing rotating stage with samples suspended for testing.

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NEWS OF INDUSTRY AND PERSONNEL

Doctor Kipp Assumes New Duties

Dr. E. M. Kipp has recently been advanced to Chief of the Lubrication Division of the Research Laboratories, a newly created department.

He was formerly Assistant Chief of the Physical Chemistry Division, in charge of the oil and lubricant section of the Aluminum Company of America. The best wishes of his many friends in the Society go with him as he assumes his new responsibilities.

Annual Meeting N. L. G. I. at the Edgewater Beach Hotel October 16th through 18th

Approximately 300 people checked in at the registration desk on October 15th for the convention of the National Lubricating Grease Institute at the Edgewater Beach Hotel. It was the largest convention in N.L.G.I. history. Seven papers were read before the convention sessions, with each speaker an outstanding authority in his particular field.

The officers elected for the coming year are:

President, J. R. Corbet
Vice President, B. G. Symon
Treasurer, E. V. Moncrieff
Executive Secretary, Carl E. Bolte.

Clower Speaks at Hydraulic Conference

The National Conference on Industrial Hydraulics held at the Sheraton Hotel in Chicago on October 17th was well attended, lasting two days. It was sponsored by the Armour Research Foundation in conjunction with several other engineering societies.

Dr. J. I. Clower, Chairman of the Division of Mechanical Engineering at the University of Delaware, gave an interesting talk on hydraulic fluids and their application.

The conference is the third annual session to be held by this group.

New Literature

Dow Corning Corporation, Midland, Mich., have released new data concerning a series of Silicon Oils which are claimed to have special heat stability combined with new resistance to oxidation, freedom from greasing, water repelency, low volatility, and high flash point. The lubricants are claimed to be effective in use at temperatures of 10 F to 500 F.

Detailed test results and physical properties of these Silicon oils are contained in the new Silicon notes. Preliminary Data Sheet A-20-1. Write to this Publication, or Dow Corning Corporation, Midland, Michigan.

New Booklet Offer on "UCON" Fluids and Lubricants

Publication of a new booklet on UCON fluids and lubricants (Polyalkylane Glycols and Derivatives) is a new booklet recently published by the Special Products Division of Carbide & Carbon Chemical Corporation. This booklet discusses in detail the important properties and uses of several series of UCON fluids and lubricants. Copy may be obtained from any office of Carbide & Carbon Chemical Corporation by asking for Form 6500.

Tony Zino Joins Swan-Finch As Assistant Sales Manager

Mr. S. W. Bodman, Jr., Manager Industrial Sales Division, Swan-Finch Oil Corp., announces the appointment of Mr. Anthony J. Zino. Jr., as Assistant Sales Manager of the Industrial Sales Division with headquarters in the home office, R.C.A. Building, New York.

ANTHONY J. ZINO

With an extensive background of 13 years in lubrication sales engineering, Mr. Zino comes well qualified for his duties in developing applications for industrial lubricants, and cutting and drawing compounds. He holds a B.S. in Chemical Engineering from Case Institute of Technology and is active in the American Society of Lubrication Engineers, S. A. E., Army Ordnance Assn., American Society of Metals and the A.S.T.M. He is author of a series of articles, a definitive study of petroleum oils used in hydraulic equipment — currently appearing in *American Machinist*. Prior to his present connection, Mr. Zino was, for 8 years, Sales Engineer and New York Sales Manager of Lubri-Zol Corp., where his experience included extensive field research on the development of additives and treated oils, and for the last 5 years, Eastern Manager of the Lubrication Department of E. F. Houghton & Co.

New Motor-Mica Package

Scientific Lubricants Company announces that their product Motor-Mica Anti-Friction Compound is now available in a new size container, tubular in shape, measuring 2¾x1⅝, with a weight of only two ounces, being specially designed to permit carrying in tool kits and otherwise conveniently handled. The product is a clean white anti-friction compond in powdered form, especially prepared for use as a general lubricating aid and is used extensively in poring, threading, drilling, tapping, and die casting. For complete details write to this Publication, or Scientific Lubricants Company, 3469 No. Clark Street, Chocago 13, Ill.

The Alemite Division of the Stewart-Warner Corporation of Chicago, Illinois, announces the appointment of Mr. R. W. Fritz, formerly of the Tucker Plant in Chicago to the Lubrication Department of the Alemite Division.

Mr. Fritz has a wide experience in lubrication as he was formerly with the International Harvester Company, Buick Company, and most recently with the Dodge Chicago Plant.

Announcement of the appointment of new representatives to handle the line of HILCO lubricating, fuel, and industrial oil purifying was made by T. A. LaBrecque, Manager of the Oil Purifier Division of The Hilliard Corporation, Elmira, N. Y.

The new representatives are:

HUCKER SALES COMPANY, 1700 Walnut Street, Philadelphia 3, Pennsylvania, to operate in the Philadelphia area.

R. T. WHITSON & SON, 723 Transportation Building, Cincinnati 2, Ohio, to operate in the Cincinnati area.

L. M. SANDS & COMPANY, 246 Ritch Street, San Francisco, California, to operate in the State of California. Supplies are warehoused at San Francisco for convenient distribution to Hilliard customers on the West Coast.

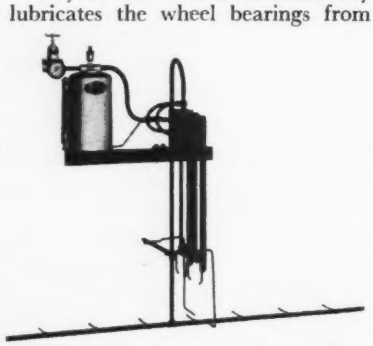
R. E. CHASE & COMPANY, Tacoma Building, Tacoma 2, Washington, to operate in the Washington and Oregon area.

These appointments are in line with the Hilliard plan of expanding their sales organization to give more complete coverage and service to their customers throughout the country.

Mr. LaBrecque also indicated that Hilliard has two new booklets on oil maintenance equipment: one, describing the complete line of HILCO Oil Reclaimers, Airline Oil Purifiers, and Hyflow Oil Filters; and the second, covering HILCO equipment for the proper maintenance of lubricating and fuel oil for Diesel locomotive operators. These booklets are available by writing directly to district representatives or to The Hilliard Corporation, 102 West Fourth Street, Elmira, New York.

New Type Conveyor Lubricators for High Temperature Operation

J. N. Fauver Company announces a new type of Automatic Lubrication System for conveyors operating through high temperatures. According to the manufacturers this installation operates successfully twenty-four hours per day in temperatures to 550 F. Each unit is mounted on top of the 6" I-Beam which carries conveyor wheels and automatically lubricates the wheel bearings from

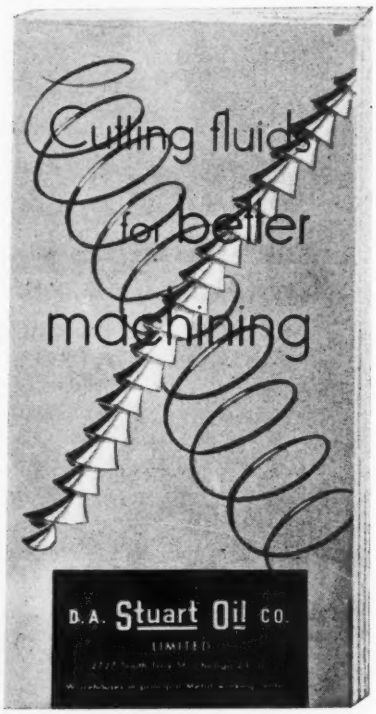


each side of the two wheels above each hanger. Many other types of conveyor lubricators have been developed by Fauver lubrication engineers. Each installation is tailer-made to fit specific requirements, whether they be extremes of heat or cold, high or low speed of travel or other unusual conditions. It is claimed by the manufacturers that there is no excess to drip, a factor of importance in food handling and processing plants.

New Revised Edition of Stuart Manual "Cutting Fluids for Better Machining"

Completely revised edition of the booklet, "Cutting Fluids for Better Machining," a seventy-two page catalogue of metal-working information, has been published by the D. A. Stuart Oil Company.

Revised to keep pace with the latest metal cutting developments,



the booklet contains a wealth of data on the application of Stuart Oils for cutting, grinding, drawing, quenching and tempering, and all other phases of metalworking and industrial lubrication. In addition, useful sections on Metal Cutting Mechanisms, The Selection of Cutting Fluids, Rules for Prolonging Tool Life, handy tables of Standard Steel Specifications, Independent Research Committee Data and Marking System Chart for grinding wheels are included.

This convenient pocket-size reference handbook is available to men of the metalworking industries without charge by writing D. A. Stuart Oil Company, 2729-53 South Trop Street, Chicago 23, Illinois.

OILS AND LUBRICANTS PATENT ABSTRACTS

Lubricant Composition—Patent #2,424,588—William J. Sparks and David W. Young, assignors to Std. Oil Development Co. A lubricant comprising a liquid petroleum hydrocarbon fraction containing dissolved therein about 0.5% to 30% of a linear polyester condensation product of a dimer of an unsaturated vegetable oil fatty acid with a glycol of the general formula HO—R—OH, in which R is an aliphatic hydrocarbon group, said condensation products having an average molecular weight of at least 2000.

Synthetic Lubricant—Patent #2,424,956—Orland M. Reiff, Howard D. Hartough, and Harry J. Andress, Jr., assignors to Socony-Vacuum Oil Company, Inc. The method of preparing a synthetic lubricant of low pour point and susceptible of substantial pour point lowering, from a crystalline paraffin wax having a melting point not greater than about 140°F. and a xylene, which comprises: partially halogenating the paraffin wax to form a mixture of halogenated wax and substantially unhalogenated wax, said mixture being selected from the group consisting of a mixture containing an amount of halogen corresponding to from 12 to 27% chlorine; mixing the halogenated wax and unhalogenated wax with said xylene in the proportion of at least one mol of xylene to each atom of halogen in the halogenated wax mixture; adding thereto a catalyst capable of effecting a Federal-Crafts typ condensation; heating the mixture thus obtained at a Friedel-Crafts condensation temperature untill substantially all of the halogenated wax has reacted with said xylene; and separating the Friedel-Crafts catalyst, unreacted xylene and unhalogenated wax from the reacction mixture, so obtained, to obtain said synthetic lubricant.

Oil Purifying Substances and Method of Making the Same—Patent #2,425,085—Harold F. Dague, assignor of one-half to William B. Collins. A composition of the character described comprising about 35% to 55% by weight of an oil-soluble tertiary organic amine, about 5% to 25% by weight of an oil-soluble sulfonic acid salt and about 30% to 50% by weight of a substantially neutral, predominantly hydrocarbon mixture extracted from petroleum with furfural.

Lubricant Composition—Patent #2,425,174—Emmett S. Carmichael and Theodore G. Roehner, assignors to Socony-Vacuum Oil Co., Inc.

A lubricant for use in the cold rolling of steel comprising an emulsion wherein water is the continuous phase and the disperse phase is a water-in-oil emulsion, said composition being constituted of water, a lubricating oleaginous material, an emulsifier capable of emulsifying the oleaginous material in water, and sufficient amount of a salt of a polyvalent metal to bring about the formation of an emulsion of the compound type.

Process for Breaking Petro'eum Emulsions — Patent #2,425,175—Paul G. Carpenter, assignor to Hercules Powder Co.

A process for breaking pretroleum emulsions of the water-in-oil type which comprises subjecting the emulsion to the action of an animated chlorinated paraffin which is characterized by a nitrogen content of about 1% to about 11% and a chlorine content of about 2% to about 20%.

Modifying Drying Oils—Patent #2,425,200—Floyd G. Nessler and Charles E. Penoyer, assignors to The Sherwin-Williams Co.

The method of modifying a non-hydroxylated, non-ketonic type of drying oil having non-conjugated double bonds to improve the oil as to at least one of the characteristics of drying speed and heat bodying speed, comprising heating the oil to a temperature in the range of 240°C. to 340°C. and intimately contacting the oil at such a temperature with an anhydride of saturated, aliphatic, Mono-Carboxylic acid having up to five carbon atoms for a time sufficient to effect such modification of the oil by contact with the anhydride.

Electrical Apparatus for Separating the Constituents of an Oil-Water System—Patent #2,425,355—Claudius H. M. Roberts, assignor to Petrolite Corp., Ltd.

In combination, with a receptacle containing superimposed bodies of liquids comprising respectively oil and water which has separated from the oil, a device for resolving sludge in a sludge zone maintained in a substantially fixed position just above the separated water, which device includes: a pair of elongated electrodes extending in said sludge zone and spaced from each other; means for insulating one of said electrodes from the other and for retaining said electrodes side by side in spaced relation; means for impressing a potential difference between said electrodes whereby an electric field is established therebetween of such intensity as to resolve the sludge; and means for moving said electrodes in said sludge zone as a unit to bring different portions of said sludge into the electric field between said electrodes.

Lubricating Oil Composition—Patent #2,425,747—Eugene Lieber and Marvin E. Thorner, assignors to Standard Oil Development Co.

A lubricating composition comprising a major proportion of a lubricating oil base stock and a small amount of a condensation product of an aliphatic mono-hydroxy alcohol having less than 7 carbon atoms and an aromatic compound having less than 4 aromatic nuclei, said condensation product being substantially non-volatile at about 600°F. under reduced pressure and having the property of depressing the pour point of waxy mineral lubricating oils when added thereto in small amounts.

Printed copies of patents are available from the Patent Office at twenty-five cents each. Address the Commissioner of Patents, Washington, D. C., for copies and for general information concerning patents.

From Official Gazette—Vol. 600, No. 5; Vol. 601, Nos. 1, 2, 3, 4; Vol. 602, Nos. 1, 2, 3, 4, 5.

Prepared by ANNE BURCHICK

Electrical Oil—Patent #2,425,791—Edward S. Flynn, assignor to Anaconda Wire and Cable Co.

An improved electrical insulating oil consisting of a highly refined mineral oil suitable for use as an insulating medium in electrical equipment which has been stabilized against the deleterious action of micro-organisms therein by incorporation in the oil of about 0.05 to 0.2% by weight of napthoquinone.

Lubricating Apparatus—Patent #2,425,867—Ernest W. Davis.

In a grease gun, the combination of a head having a feed cylinder, a plunger reciprocable therein, a grease reservoir adjoining the head, said head having a pocket and a port leading from said pocket through which port the grease moves from the interior of the reservoir into said cylinder, a check valve outlet for said cylinder, means to reciprocate the plunger, a member having an area approximating the cross-sectional area of said pocket and mounted in the reservoir adjacent said port and movable into and out of the pocket for compacting the grease in and around the port, and means for so moving said member when the plunger is reciprocated.

Stabilizing Marine Oils—Patent #2,426,485—Loran O. Buxton and Charles E. Dryden, assignors to Nopco Chemical Co.

A process for increasing the stability of a rendered crude fish liver oil, which comprises heating an organic solvent solution of such an oil in contact with concentrated ammonium hydroxide and subsequently freeing the oil of ammonia, water and solvent by heating the mass under reduced pressure.

Process of Producing Hydrocarbon Oil Concentrates of Barium Sulfonates—Patent #2,426,540—Franklin M. Watkins and Theodore A. Hauk, assignors to Sinclair Refining Co.

A process for producing petroleum oil concentrates of barium sulfonates which comprises agitating for a period not exceeding about 30 minutes a sulfuric acid-treated Mid-Continent crude base distillate at a temperature between 50°F. and 135°F. with anhydrous barium hydroxide having a particle size of not substantially coarser than about 100 mesh, the barium hydroxide being employed in substantial excess as determined by the acid number of the oil, adding to and intimately admixing with the mixture of oil and barium hydroxide from 2.2 to 7% of water, allowing the aqueous mixture to settle until formation of two layers occurs, the mixing period following addition of the water having been of a duration insufficient to result in the formation of a homogeneous reaction mixture, and separating the lower layer, having a relatively high concentration of barium sulfonates, from the upper layer, having a relatively low concentration of barium sulfonates.

High Temperature Lubricant—Patent #2,426,852—Donald L. Wright, assignor to Jasco, Inc.

The method of lubricating hot metal surfaces which, in the absence of a lubricant, would move in contact with each other, at temperatures above about 500°F., which comprises applying to said moving metal parts a lubricant comprising a major proportion of a volatile hydrocarbonsolvent having a boiling range within 140°F. and 750°F. having a viscosity below 45 seconds Saybolt at 100°F. and capable of evaporating at such high temperatures without leaving any harmful residue, said lubricant also containing a sufficient amount of an oil-soluble organic thickener comprising essentially a substantially saturated oxygen-containing viscosity-increasing linear aliphatic polymer having a molecular weight of at least 1,000 adapted to be decomposed at such high temperatures without leaving any substantially harmful residue, to make a solution having a viscosity of at least 100 seconds Saybolt at 100°F., and said thickener being a polymer of an oxygen-containing compound having the group

$$\begin{matrix}1\\ -C{=}CH_2\end{matrix}$$

in its molecular structure.

Lubricant Composition—Patent #2,426,549—Walter J. Coppock, assignor to Sun Oil Co.

A mineral oil lubricant composition containing a small proportion of thymol effective to substantially inhibit oxidation and a small rust preventive proportion of a substance comprising a substituted 1,2-dihydroxybenzene having as the substituent a saturated aliphatic hydrocarbon group attached to the benzene ring in the para position and containing 4-12 carbon atoms.

Lubricant Composition—Patent 2,426,983—Austin T. Collins.

A dispersion of synthetic graphite in a volatile liquid for coating surfaces by drying through volatization consisting essentially of about one part of synthetic graphite, about four parts of methyl alcohol, and about forty-five to sixty parts of a volatile chlorinated hydrocarbon of the class consisting of carbon tetrachloride and trichlorethylene, said parts being by volume.

Mineral Oil Composition—Patent #2,427,272—Everett W. Fuller, Horace E. Redman, and Henry G. Berger, assignors to Socony-Vacuum Oil Co., Inc.

An improved mineral oil composition comprising a major proportion of a viscous mineral oil fraction having in admixture therewith a small amount, sufficient to enhance the stability of said oil fraction, of an oil-soluble, phosphorus-and sulful-containing material selected from the group consisting of an acidic reaction product, an ammonium salt thereof and a metal salt thereof, said acidic reation product being obtained by reaction at a temperature between about 50°C. and about 125°C. of phosphorus pentasulfide and an oxidized paraffin wax characterized by a neutralization number from about 5 to about 60 and hydroxyl and saponification numbers of at least about 20, said oxidized paraffin wax being obtained by oxidizing a paraffin wax having about 24 carbon atoms and an A.S.T.M., melting point of 126°F.

Treatment of Mineral Oil Emulsions—Patent #2,427,326—Paul M. Goodloe and Thomas T. Noland, assignors to Socony-Vacuum Oil Co., Inc.

A process for esparating mineral oil emulsions of the water-in-oil type into their constituent parts, which comprises subjecting an emulsion to the action of an emulsion breaker which includes a colloidally active organic substance which tends to stabilize emulsions of the oil-in-water type, water, and urea.

Oil Compound—Patent #2,427,501—Milton P. Kleinholz, assignor to Sinclair Refining Co.

An improved mineral oil composition which comprises a petroleum lubricating oil fraction with which there has been compounded minor proportions, effective to retard rusting, of alpha, alpha'-thiodilauric acid and alpha-hydroxylauric acid, the relative proportions of the alpha, alpha'-thiodilauric acid and the alpha-hydroxylauric acid being within the range of about 80 to 50 parts of the former to about 20 to 50 parts of the latter.

Method of Refining Hydrocarbon Oil with a Sludge-Forming Reagent — Patent #2,427,589 — Vladimir L. Chechot, assignor to The Atlantic Refining Co.

The method of refining hydrocarbon oil, which comprises intimately mixing said oil with a sludge-forming reagent, supplying said mixture in the form of a film to an inclined surface heated to a temperature sufficient to coke the sludge resulting from the reaction of the sludge-forming reagent with the oil but nsufficient to deleteriously affect the oil, depositing and coking the sludge upon said heated surface, and separately removing said coked sludge and the treated oil from said surface.

Compounded Lubricating Oil—Patent #2,427,766—Hyman Diamond, assignor to Shell Development Co.

A hydrocarbon lubricating oil composition initially having a content of less than about 6% of aromatic compounds, the oxidation stability of which has been increased by the addition of an anti-oxidant amount of the combination of an oil-soluble halogen-free organic sulfide and between about 0.2% and about 15% of a highly oil-soluble condensed ring polynuclear aromatic hydrocarbon.

Treatment of Hydrocarbon Oil—Patent #2,428,067—George H. Evans, Ferdinand T. Klopsch, and Darwin M. McCormick, assignors to The Atlantic Refining Co.

The method of avoiding emulsification difficulties and promoting the separation of the raffinate phase from the extract phase in the selective solvent extraction of viscous hydrocarbon oil employing nitrobenzene as the extraction solvent, which comprises adding to the extraction system a small amount of ammonia and of an alkaline earth metal soap of a fatty acid sufficient to promote phase separation.

Soda Base Grease — Patent #2,428,123 — John D. Morgan and Russell E. Lowe, assignors to Cities Service Oil Co.

A lubricating grease comprised mainly of lubricating oil containing at least 20 per cent by weight of refined Mid-Continent base stock, and from about 10 to 30 per cent by weight of sodium stearate, in which the oil-stearate mixture is subjected to a finishing temperature of from 550° to 600° F., and is followed by quick chilling, to render the final product highly resistant to dissolution in water.

Members of the American Society of Lubrication Engineers*

(As of November 15, 1946)

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Faber Laboratories of N. Y.
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Fairchild Engine & Airplane Corp.
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FARRINGTON, BRUCE B.
California Research Corp.
P. O. Box 1627
Richmond, California

FARRY, JAMES E.
Alemite Co.
1027 Main Street
Buffalo, N. Y.

FAUVER, JOHN W.
J. N. Fauver Company
49 West Hancock Street
Detroit 1, Michigan

FAUST, HARRY W.
Monsanto Chemical Co.
1700 South 2nd St.
St. Louis 4, Mo.

FELDSCHER, Lewis A.
Dirkes Industries, Inc.
2035 Gratiot
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FERRIE, PARMELY T.
The J. W. Kelley Co.
3401 West 104th St.
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FEWSMITH, A. GRANT
Panther Oil & Grease Mfg. Co.
840 N. Main St.
Forth Worth 1, Texas

FINDLAY, GEORGE
Republic Steel Corporation
1175 South Park Avenue
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Alemite Co. of Pittsburgh
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FINNERAN, PAUL J.
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Gulf Refining Co.
250 Jeff Street
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FISHER, FRANK G.
Honan-Crane Corp.
1200 Indianapolis Ave.
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FISKE, CHARLES D., Jr.
Bijur Lubricating Corp.
7-250 General Motors Bldg.
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FITCH, L. W.
Dingle-Clark Co.
1248 Engineers Building
Cleveland 14, Ohio

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FLETCHER, W. A.
E. F. Houghton & Co.
Quint & Davidson
San Francisco 24, California

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The Atlantic Ref. Co.
260 S. Broad St.
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Standard Oil Co. of California
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Socony-Vacuum Oil Co.
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FOWLER, WILLIAM H.
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American Oil Co.
Tryon & Morehead Sts.
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Shell Oil Co., Inc.
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FRANTZ, LEROY J.
The Texas Co.
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FRAZER, ANDREW H.
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FRAZIER, CHARLES H.
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Socony Vacuum Oil Co., Inc.
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FRIER, JAMES H.
Kaiser Company, Inc.
Iron & Steel Div.
Fontana, California

FRIER, JAMES W.
Alemite Co. of So. Calif.
333 Washington St.
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FROHMAN, OSCAR
Ampco Metal, Inc.
1745 South 38th St.
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FUHR, WAYNE S.
Hanna Coal Co.
St. Clairsville, Ohio

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Ladish Drop Forge Co.
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Dirkes Industries, Inc.
2035 Gratiot
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GAUL, JOHN W.
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GEEN, CORY P.
Sun Oil Co.
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GEISINGER, CHARLES A.
B. F. Goodrich Co.
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GENTHE, WALTER A.
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GEORGI, CARL W.
Quaker State Oil Refining Corp.
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GERIN, FERNAND L.
Youngstown Miller Co., Inc.
675 Main St.
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GERSTUNG, H. S.
Sinclair Refining Co.
630 Fifth Ave.
New York 20, N. Y.

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Shell Oil Co., Inc.
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Adam Cook's Sons Inc.
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GILLETTE, CHARLES R.
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GITZEN, JOSEPH A.
Delta Oil Products Co.
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GOBLE, R. D.
Skinner Purifiers, Inc.
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Ingersoll--Rand Co.
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Gordon Lubricating Co.
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GORNEY, HENRY E.
Standard Register Co.
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GORSLINE, ROBERT J.
S. F. Bowser Co., Ltd.
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GOTHARD, N. J.
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GOTTFRIED, NORMAN M.
Carnegie-Illinois Steek Corp.
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Carnegie Illinois Steel Corp.
Gary Steel Works
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GREGG, James K.
Perfect Circle Co.
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Stevens Grease & Oil Co.
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Jos. H. Yerkes & Co.
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Haggerty Refining Co.
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Metal Lubricants Co.
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Joseph Woodwell Co.
N. W. Cor. Wood St. & Blvd. of Allies
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HIDDEN, TODD C. E.
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HIGGINS, EDWIN M.
Master Lubricants Co.
Meadow and Jackson Sts.
Philadelphia, Pennsylvania

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Essex Brass Corp.
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Standard Oil Co. of Pa.
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Shell Oil Company, Inc.
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HOCKE, JAMES N.
Talon, Inc.
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Hodson Corp.
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HODSON, LEE N.
Hodson Corp.
5301 W. 66th Street
Chicago 38, Illinois

HODSON, WALTER H.
Hodson Corp.
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HOLLAND, LEONARD C.
Shell Oil Co., Inc.
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HOLLINGSWORTH, DWIGHT F.
E. I. duPont deNemours and Co.
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Wilmington 98, Delaware

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Socony Vacuum Oil Co.
59 E. Van Buren St.
Chicago 5, Illinois

HOLMES, ROBERT L.
Ternstedt Mfg. Co.
6307 West Fort St.
Detroit 9, Michigan

HOLT, JAMES OSCAR
Sinclair Refining Co.
573 West Peachtree St.
Atlanta, Georgia

HOOD, WALTER S.
Hood Refining Co.
21 N. Hamilton St.
Greensburg, Pa.

HOPKINSON, JAMES W.
Penn Petroleum
5690—12th Street
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HORWITZ, Albert S.
E. F. Houghton & Co.
Quint and Davidson
San Francisco, California

HORWITZ, WALTER N.
Sun Oil Co.
1608 Walnut St.
Philadelphia 3, Pa.

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Pontiac Motor Div.
Glennwood Ave.
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HOWELL, K. M.
Standard Oil Co. (Ohio)
1315 Poland Ave.
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922 Sheridan St.
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HUEBLER, CHARLES D.
The Texas Co.
6707 Dix
Detroit, Michigan

HUEY, CHARLES L.
Aluminum Co. of America
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HUISKEN, ARTHUR H.
Sinclair Ref. Co.
2540 W. Cermak Rd.
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Socony-Vacuum Oil Co.
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Chicago 5, Illinois

HUMES, ERWIN W.
Socony-Vacuum Oil Company
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HUNTER, B. F.
Honan-Crane Corp.
Lebanon, Ind.

HUNTOON, CALVIN B.
Shell Oil Co., Inc.
290 Larkin St.
Buffalo, N. Y.

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Socony-Vacuum Oil Co.
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HURTT, W. T.
United Oil Co.
1800 N. Franklin St.
Pittsburgh 12, Pa.

HURWITZ, WILLIAM S.
The Texas Co.
Houston, Ave.
Port Arthur, Texas

HUTTON, VIRGIL C.
Delco Products Div. of G. M.
329 E. First St.
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IRGENS, F. T.
Evinrude Motors
4143 N. 27th Street
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ISBELL, HARVEY G.
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H. K. Stahl Co.
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The Farval Corp.
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JENNINGS, BURGESS H.
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JESSE, RICHARD J.
Pyle National Co.
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Calumet Refining Co.
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50 W. 50th Street
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Pittsburgh Equitable Meter Co.
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Socony-Vacuum Oil Co.
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Standard Oil Co.
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JOHNSON, WILLIAM O.
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Standard Oil Co.
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Gulf Oil Corp.
Gross St. and P. R. R.
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JONES, WILLIAM CARTER
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JOSSMAN, WALLACE
The Alemite Co.
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KASMARK, J. W.
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KATZ, WILLIAM B.
Van Straaten Chemical Co.
337 West Madison Street
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KAVANAGH, F. W.
California Research Corp.
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Richmond, California

KAYSER, HENRY W.
The Falk Corp.
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KEATING, HAROLD B.
Shell Oil Co., Inc.
Martinez Refinery
Martinez, California

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Gisholt Machine Co.
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Milwaukee, Wis.

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Carnegie Illinois Steel Corp.
Duquesne, Pennsylvania

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Buffalo Tank Corporation
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Canfield Oil Co.
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Van Straaten Chem. Co.
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KRAUSE, WALLACE H.
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LAWTON, MORGAN B.
Lincoln Engineering Co.
8627 Woodward Ave.
Detroit 2, Mich.

LEISTER, ROBERT G.
Alan Wood Steel Co.
Conshohocken, Pa.

LEMPERT, FRANK C.
Tide Water Assoc. Oil Co.
1510 Arrott Building
401 Wood Street
Pittsburgh 22, Pennsylvania

LENDWAY, JOSEPH M.
Shell Oil Co.
154 Bagley Ave.
Detroit 26, Mich.

LEONARD, WILLIAM F.
Secretary and Treasurer, ASLE
343 S. Dearborn St.
Chicago 4, Ill.

LEVALLY, JOHN R.
Lincoln Engineering Co. of Illinois.
2415 South Michigan Avenue
Chicago 16, Illinois

LEVEY, NORMAN J.
Lincoln Engineering Co.
8627 Woodward
Detroit 2, Mich.

LEWIS, JAMES H.
Carnegie, Ill., Steel Corp.
Clairton Works
Clairton, Pa.

LEWIS, RAY D.
Texas Company
3300 Beekman St.
Cincinnati 6, Ohio

LEWIS, WILLIAM E.
The Pure Oil Co.
39th & Neville Sts.
Pittsburgh 16, Pa.

LIBERTHSON, LEO
L. Sonneborn Sons. Inc.
88 Lexington Avenue
New York 16, New York

LICHTY, D. E.
National Refining Co.
621 South 12th St.
Milwaukee 4, Wis.

LIEBER, EUGENE
Armour & Co.
Research and Devel. Dept.
U. S. Yards
Chicago 9, Illinois

LIEBERMAN, ARTHUR ARNOLD
Petroleum Marketing Co.
4410 District Blvd.
Los Angeles 11, California

LIEN, ELVIN B.
Union Oil Co. of Cal.
425 First St.
San Francisco, California

LILLIE, JAMES S.
The Pennzoil Co.
942 South Hope
Los Angeles 15, Cal.

LILLMARS, C. ARVID
Petroleum Equipment Co.
3117 North Broad Street
Philadelphia, Pennsylvania

LINDQUIST, WILLIAM R.
Warren Refining and Chemical Co.
5151 Denison Avenue
Cleveland, Ohio

LINK, G. H.
325 Mohawk Drive
Dearborn, Michigan

LINN, FRANK C.
General Electric Co.
1 River Road
Schenectady, N. Y.

LINNEAN, H. W.
Dirkes Industries, Ind.
2035 Gratiot
Detroit, Mich.

LINVILL, ALBERT C.
Farval Corp.
327 S. LaSalle St.
Chicago, Ill.

LOCKER, P. H.
Standard Oil Company (N. J.)
Box 66
Linden, New Jersey

LO PRETE, JAMES U.
Alemite Co.
15501 Woodrow Wilson Ave.
Detroit, Michigan

LOWE, CLYDE L.
Lukens Steel Co.
Coatesville, Pa.

LOWMAN, ALBERT H.
The Texas Co.
111 State St.
Camp Hill, Pennsylvania

LUNDQUIST, JOSEPH T.
Lincoln Engineering Co. of Ill.
2415 S. Michigan Ave.
Chicago 16, Ill.

LUNZ, GILBERT M.
Lincoln Engineering Co.
2415 S. Michigan Ave.
Chicago 16, Ill.

LYKINS, JOSEPH D.
Wheeling Steel Co.
Yorkville, Ohio

MAAG, O. L.
Timken Roller Bearing Co.
Canton 6, Ohio

MAAS, JOHN B.
Crest Sales & Supply Co., Inc.
1936 W. Lafayette Blvd.
Detroit 16, Mich.

MacBETH, WILLIAM
Standard Oil Co. of Pa.
35th and W. V. R. R.
Pittsburgh, Pa.

MAGILL, F. R.
1022 Empire Building
Pittsburgh, Pennsylvania

MAHAFFAY, ROBERT J.
The Chek-Chart Corp.
624 S. Michigan Ave.
Chicago 5, Ill.

MAHNCKE, HENRY E.
Westinghouse Research Lab.
East Pittsburgh, Pennsylvania

MANDY, W. H.
The Texas Co.
154 Spring Grove Road
31 Terminal Way
Pittsburgh, Pa.

MANLEY, LEO W.
Socony Vacuum Oil Co., Inc.
R & D Labs.
Paulsboro, N. J.

MANTEUFFEL, ALLAN A.
Pure Oil Research & Dev. Labs.
Box 266
Winnetka, Ill.

MARA, JAMES H.
Socony-Vacuum Oil Co., Inc.
4140 Lindell
St. Louis 8, Mo.

MARIS, JOHN H.
L. R. Kerns Co.
5579 Pershing Ave.
St. Louis 12, Missouri

MARKHAM, L. H.
War Department, AAF
Wright Field
Dayton, Ohio

MARKLE, EDWARD L.
Shell Oil Co., Inc.
290 Larkin St.
Buffalo, N. Y.

MARLEY, SAMUEL P.
Socony Vacuum Oil Co.
412 Greenpoint Ave.
Brooklyn 22, N. Y.

MARLOW, CHARLES WILLIAM
Standard Oil Co.
Route 25
Linden, N. J.

MARSHALL, THOMAS A.
Steel Co. of Canada, Ltd.
Wilcox, Hamilton, Ont., Canada

MARSHALL, W. A.
Alemite Co.
15501 Woodrow Wilson Avenue
Detroit 3, Michigan

MARTIN, JAMES E.
Mid-Continent Petroleum Corp.
Box 60,
Waterloo, Iowa

MARTIN, RALPH V.
Union Oil Co.
Emeryville, Cal.

MATTE, GERARD A.
Cities Service Oil Company (Pa.)
70 Pine Street
New York 5, New York

MATTHEWS, RALPH R.
Battenfeld Grease & Oil Co.
3148 Roanoke Road
Kansas City 8, Missouri

MAY, EDWIN M.
Bowser, Inc.
420 Lexington Avenue
New York 17, New York

McARDLE, F. F.
The Youngstown Sheet & Tube Co.
Brier Hill Works
Youngstown 21, Ohio

McCARTHY, G. NORMAN
Texas Company
26 Lansing Street
Buffalo, New York

McCarthy, William A.
Tide Water Assoc. Oil Co.
17 Battery Place
New York, New York

McCASLIN, R. H.
National Refining Co.
1455 Miami Avenue
Toledo, Ohio

McCLELLAN, CHARLES R.
Standard Oil Co. of Cal.
533 Jergins Trust Bldg.
Long Beach 2, California

McCLUNG, ERNEST E.
Van Straaten Chemical Co.
337 West Madison Street
Chicago 6, Illinois

McCRARY, R. A.
Alemite Co. Eastern Pa.
704 North 16th St.
Philadelphia 30, Pennsylvania

McCUTCHEON, CURTIS A.
45-42 43rd St.
Long Island City
New York

McDONALD, EDMUND B.
Alemite Co. of Buffalo
26 Goodrich St.
Buffalo 3, New York

McGAR, BENJAMIN H.
Chase Brass & Copper Co., Inc.
236 Grand Street
Waterbury 91, Connecticut

McGINTY, ALFRED L. JR.
International Distributing Co.
P. O. Box 2508
Birmingham 1, Alabama

McGONIGLE, JOSEPH R.
Humble Oil & Ref. Co.
P. O. Drawer 180
Abilene, Texas

McGROGAN, JOHN F.
Atlantic Refining Co.
3144 Passyunk Avenue
Philadelphia, Pennsylvania

McHENRY, H. J.
Johns Manville
610 Clarke Building
Pittsburgh 22, Pennsylvania

McHENRY, KENNETH E.
Bethlehem Steel Co.
Hamburg Turnpike
Lackawanna, N. Y.

McKAIG, WILLARD H.
International Business Machines Corp.
Endicott, New York

McKEE, JOHN R.
Fiske Bros. Refining Co.
1500 Oakdale Ave.
Toledo 3, Ohio

McKIBBEN, ROBERT F.
National Cash Register Co.
S. Main and K St.
Dayton 9, Ohio

McLAREN, J. HAROLD
William B. Pierce Co.
133 S. Division St.
Buffalo 3, New York

McLEAN, EDWIN G.
Dirkes Industries
2035 Gratiot
Detroit, Michigan

McLENNAN, LESTER W.
Union Oil Co. of Cal.
Oleum, California

McMURTRY, ERMIL W.
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Ironsides Company
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3083 Broadway Ave.
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MEIER, E. D.
Harvey Machine
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Los Angeles, California

MERCER, MARC E.
Trabon Engineering Corp.
3058 North 75th St.
Milwaukee 13, Wisconsin

MERCHANT, MYLON EUGENE
Cincinnati Milling Machine Co.
Research Dept.
Cincinnat 9, Ohio

MERGENTHALER, LLOYD W.
Atlantic Ref. Co.
260 S. Broad St.
Philadelphia, Pa.

MERGET, ANDREW E.
DeLaval Separator Company
Pine & Water Street
Poughkeepsie, New York

MESSINGER, NORMAN A.
The Atlantic Ref. Co.
260 S. Broad St.
Philadelphia 2, Pa.

MILLER, ARTHUR A.
E. F. Houghton & Co.
3516 S. Shields Ave.
Chicago 9, Ill.

MILLER, GEORGE W.
Battenfeld Grease & Oil Corp.
Box 144
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MILLER, HARRY L.
Haas-Miller Corp.
4th and Bristol Streets
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MILLETT, WILLIAM H.
Linde Air Products Co.
Tonadanda, N. Y.

MINGLE, L.
Chevrolet-Buffalo
1001 E. Delevan Ave.
Buffalo, N. Y.

MOHR, EDWARD A.
Shell Oil Company, Inc.
2015 Long Beach Avenue
Los Angeles, California

MONINGER, JAMES A.
Standard Oil Co. (Indiana)
715 East 10th Street
Wichita 1, Kansas

MONTALVO, EDWIN JAMES
James T. Gordon Co.
233 Broadway
New York, New York

MONTZHEIMER, ARTHUR M.
Aluminum Company of America
Freeport Road
New Kensington, Pa.

MOOK, ARTHUR D.
Aluminum Company of America
Lafayette, Indiana

MORENS, RALPH MICHAEL
Lincoln Engineering Co.
8627 Woodward Ave.
Detroit 2, Mich.

MORETON, DOUGLAS H.
Douglas Aircraft Company
3000 Ocean Park Boulevard
Santa Monica, California

MORGAN, EUGENE B.
Morgan Oil Co.
Wyaconda, Missouri

MORRELL, NATHAN
Camera Works—Eastman Kodak Co.
333 State St.
Rochester 4, N. Y.

MORRISON, W.
Brooks Oil Co.
336 E. Broadway,
Girard, Ohio

MORTON, H. M.
Carlock Packing Co.
Tippecanoe Road, R. D. No. 2
Canfield, Ohio

MOSTELLER, JAMES S.
Wright Field, Materials Lab.
Wright Field
Dayton, Ohio

MOULD, ARTHUR E.
Tide Water Associated Oil Co.
1515 Genesee Bldg.
Buffalo, N. Y.

MOUNTCASTLE, HENRY RICHARD
Swan-Finch Oil Corp.
P. O. Box 6327
Pittsburgh 12, Pa.

MOYER, HARRY C., Jr.
The Pure Oil Co.
Marcus Hook, Penn.
P. O. Box 515

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5701 Natural Bridge Ave.
St. Louis 20, Mo.

MUELLER, JULIUS T.
Falk Corporation
3100 W. Canal St.
Milwaukee, Wis.

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Tide Water Assoc. Oil Co.
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MULLER, HENRY
Shell Oil Co., Ind.
50 West 50th St.
New York 20, New York

MULLERWEISS, A. F.
Union Oil Co.
425—1st St.
San Francisco, California

MUNSELL, JUDSON D., JR.
Kendall Ref. Co.
77 N. Kendall Ave.
Bradford, Pa.

MURPHY, HARRY A.
Gray Co., Inc.
60 - 11 Street N. E.
Minneapolis 13, Minnesota

MURPHY, JOHN J.
Twin Coach Company
Cayuga Road
Cheektonga, N. Y.

MURPHY, WILLIAM P.
Lubri-Zol Corp.
Wickliffe, Ohio

MURRAY, DONALD
Socony Vacuum Oil Co.
428 Public Ledger Bldg.
6th and Chestnut
Philadelphia 6, Pa.

MURRAY, J. P.
Dingle-Clark Co.
311 Ross Street
Pittsburgh, Pennsylvania

NAGEL, JOHN Q.
Essex Brass Corp.
2000 Franklin Street
Detroit 7, Michigan

NAGEL, PAUL L.
Essex Brass Corp.
2000 Franklin Street
Detroit 7, Michigan

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Pure Oil Co.
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Minneapolis, Minn.

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Sun Oil Company
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Cleveland, Ohio

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Standard Oil Co. of N. J.
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New York 20, New York

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Gulf Ref. Co.
Box 110
Akron, Ohio

NICHOLSON, ROSCOE F.
Honan-Crane Corp.
50 Church St.
New York 7, New York

NIEDERLOH, EARL L.
Gray Co., Inc.
60 - 11th Avenue, N. E.
Minneapolis 13, Minnesota

NORDIN, JOHN G.
So. Calif. Gas Co.
553 Ramirez Street
Los Angeles, California

NORGREN, CARL A.
C. A. Norgren Co.
222 Santa Fe Drive
Denver, Colorado

NORRIS, HENRY LEE
(Retired)
600 West 116th Street
New York 27, New York

NORRIS, WALTER
C. A. Norgren Co.
20 N. Wacker Drive
Chicago 6, Ill.

OBERRIGHT, EDWARD A.
Socony-Vacuum Oil Co.
Research & Devel. Labs.
Paulsboro, N. J.

O'FARRELL, ROBERT MAURICE
Esso Std. Oil (Caribbean) S. A.
P. O. Box 1198
Ciudad Trujillo, Dominican Republic

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3021 West Third St.
Dayton 7, Ohio

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Sunland Refining Corp.
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OLSON, PAUL P.
General Petroleum Corp.
710—2nd Ave.
Seattle 4, Washington

ONORATO, SALAZAR E.
Union Oil Co.
425 First St.
San Francisco, California

OPPENHEIM, ARLIE C.
Firestone Tire & Rubber Co.
Pottstown, Pa.

ORTSTEIN, HERBERT L.
Pacific Mills
Lawrence, Massachusetts

OSTRANDER, HARRY S.
Sun Oil Co., Ltd.
29 Basin St.
Toronto, Ont., Canada

O'SULLIVAN, EUGENE P.
The Texas Co.
332 South Michigan Avenue
Chicago 4, Illinois

OUSDAHL, ARVILLE R.
Union Oil Co. of Cal.
Oleum, Cal.

OVERLOCK, R. F.
The Pure Oil Co.
420 Lexington
New York, N. Y.

OVERSTREET, H. A.
Richfield Oil Corp.
166 Wisconsin Ave.
San Francisco, California

PAAPE, LAWRENCE F.
Filmite Oil Corp.
Station K
Milwaukee, Wisconsin

PACHAL, ADOLPH
Service Station Equipment
101 Hanson St.
Toronto, Ontario

PALMER, CHARLES
Morgan Construction Co.
15 Belmont Street
Worcester 5, Massachusetts

PALMER, FRANCIS F.
Sun Oil Co.
760 Brooks Ave.
Rochester, N. Y.

PALMER, JOHN F., JR.
Monsanto Chem. Co.
1700 S. Second St.
St. Louis 4, Mo.

PARCHE, WILLIAM HENRY
Carborundum Company
P. O. Box 337
Niagara Falls, New York

PARR, ALLEN R.
Chevrolet Division
General Motors Corp.
8000 Van Nuys Blvd.
Los Angeles, Cal.

PASHEK, ALBERT L.
Socony-Vacuum Oil Co., Inc.
530 Hanna Bldg.
Cleveland 15, Ohio

PATE, A. M. JR.
Panther Oil & Grease Mfg. Co.
P. O. Box 711
Fort Worth 1, Texas

PAUL, ALFRED A.
Brooks Oil Co.
225 Engineering Bldg.
205 W. Wacker Dr.
Chicago 6, Ill.

PAYNE, P. S.
Richfield Oil Corp.
333 Montgomery St.
San Francisco, California

PEARSON, FRANCIS H.
Richfield Oil Corp.
333 Montgomery St.
San Francisco, California

PEEBLES, JAMES CLINTON
Illinois Institute of Tech.
3300 South Federal Street
Chicago 16, Illinois

PEEPLES, HOWARD T.
Timken Roller Bearing Co.
1835 Dueber Ave., S. W.
Canton 6, Ohio

PELLETIER, PAUL E., JR.
L. R. Kerns Co.
2657 E. 95th Street
Chicago 17, Illinois

PENDLETON, JOHN H.
Talon, Inc.
626 Arch St.
Meadville, Pa.

PENFOLD, NORMAN C.
Armour Research Foundation
35 West 33rd Street
Chicago 16, Illinois

PENNOCK, WILLIAM T.
Alemite Sales Co., Inc.
59 East 25th St.
Chicago 16, Ill.

PERINE, RALMOND R., JR.
Gulf Ref. Co.
1080 Kansas St.
Memphis, Tenn.

PERKINS, EDWARD A.
ALEMITE CO. of Buffalo, Inc.
26 Goodrich St.
Buffalo 3, N. Y.

PERKINS, HORACE P.
1320 W. North Road
Bethlehem, Pennsylvania

PERRIGUEY, WILBUR G.
Standard Oil Co. (New Jersey)
39-07 210th Street
26 Broadway Ave.
New York, N. Y.

PERSO, ERCIN E.
The Texas Co.
2211 E. Washington St.
Los Angeles 21, Cal.

PETERSON, CARL G.
Falk Corp.
3001 W. Canal St.
Milwaukee, Wis.

PETERSON, J. WILLARD
Standard Oil Co. (Ind.)
910 South Michigan Avenue
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PEUCHEN, WALTER G.
Houde Engineering Division
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Buffalo 11, N. Y.

PEW, J. S.
Sun Oil Co.
Grant Bldg.
Pittsburgh 17, Pa.

PFAFF, EDWIN I.
Trabon Engineering Corp.
1814 East 40th Street
Cleveland 3, Ohio

PHELPS, BENJAMIN B.
Detroit Transmission Div., GMC.
Farnsworth St.
Detroit 11, Mich.

PHILLIPS, KENNETH
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Pittsburgh 24, Pennsylvania

PICRAUX, T. V.
Lincoln Engineering Co.
5703 Natural Bridge Ave.
St. Louis, Mo.

PIPER, R. W.
Manufacturing—Agent
Pennwood Bldg.
Pittsburgh 21, Pa.

PIPES, GAYLE W.
MFA Oil Co.
Columbia, Mo.

PIRKLE, MORGAN W.
Faber Laboratories of New York
51-57 Franklin Street
New York 13, New York

PITT, CHARLES B.
Sun Oil Co., Ltd.
29 Basin St.
Toronto, Ont., Canada

POLICK, JOHN W.
Shell Oil Co., Inc.
523 Grant Bldg.
Pittsburgh, Pennsylvania

POPE, CHARLES L.
Eastman Kodak Co.
Kodak Park
Rochester 4, New York

POPSON, S. F.
Gulf Refining Co.
1901 South 7th Street
Louisville 1, Kentucky

POST, EVERETT C.
Tide Water Assoc. Oil Co.
East 22nd St.
Bayonne, New York

POSTELNEK, WILLIAM
L. R. Kerns Co.
2657 East 95th St.
Chicago, Illinois

POTTER, RAYMOND I.
Standard Oil Co. (Ohio)
1784 Midland Building
Cleveland, Ohio

POULSON, H. R.
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22 East 40th Street
New York, New York

POULTER, THOMAS C.
Armour Research Foundation
35 West 33rd St.
Chicago 29, Illinois

POWELL, JAMES B.
Phillips Petroleum Co.
3rd and Polk
Amarillo, Texas

POWERS, S. L.
S. L. Powers Equipment Co.
7016 Euclid Ave.
Cleveland 3, Ohio

PRENDERGAST, WILLIAM A.
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P. O. Box 509
Beacon, N. Y.

PRESTON, JOHN H.
Sinclair Ref. Co.
630 Fifth Ave.
New York 20, New York

PRICE, DANIEL J.
Inland Steel Co.
Indiana Harbor, Ind.

PRICE, DON C.
Bowser, Inc.
18247 Livernois Ave.
Detroit 21, Mich.

PRICE, HARRIE B., JR.
Sun Oil Co.
1608 Walnut St.
Philadelphia 3, Pa.

PRITCHARD, CHARLES E.
Republic Steel Corp.
25 Prospect Street
Cleveland 1, Ohio

RABA, JOSEPH B.
W. H. Baber Co.
3650 S. Homan Ave.
Chicago, Ill.

RADOSEVICH, GEORGE E.
Harnischfeger Corp.
4400 W. National Ave.
Milwaukee 14, Wis.

RAFFEL, FRANK H.
Republic Steel Corp.
Harvard Ave.
Cleveland 9, Ohio

RAHM, A. E.
War Dept., AAF Wright Field
Dayton, Ohio

RAISIG, CHARLES
Mesta Machine Co.
Homestead
Pittsburgh, Pennsylvania

RAMP, W. F., SR.
Alemite Co. of the Northwest
424 N. W. 14th Ave.
Portland 9, Oregon

RANDALL, CLARK C.
Sinclair Refining Co.
2540 W. Cermak Road
Chicago 8, Illinois

RANDALL, MERLE
Randall and Sons
2521 Etna St.
Berkeley 4, California

RANEY, J. H.
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Standard Oil Co. of Pa.
Conners Crossing
Schuykill Haven, Pa.

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RETTIG, MARION H.
Bowser, Inc.
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Ft. Wayne 5, Indiana

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McKees Rocks, Pa.

REYNOLDS, HARRY W.
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RICHARDS, JOHN H., Jr.
Apex Alkali Prod. Co.
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RIGBY, JOSEPH A.
The Brooks Oil Co.
315 E. Carson St.
Pittsburgh 19, Pennsylvania

RIGG, D. D.
Sinclair Ref. Co.
135 South 56th St.
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Trabon Engineering Corp.
1022 Empire Building
Pittsburgh 22, Pennsylvania

ROBERT, F. C.
Gulf Oil Corp.
Gross and P. R. R.
Pittsburgh, Pennsylvania

ROBERTSON, B. P.
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ROBISON, ROBERT V.
Dingle-Clark Co.
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ROBSON, ERNEST S., JR.
Monsanto Chem. Co.
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ROBSON, N. STEWART
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ROEDER, CARL O.
Farval Corp.
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Brooklyn 22, N. Y.

ROOSA, HERBERT H.
Manzel, Inc.
315 Babcock St.
Buffalo 10, New York

ROSENSTIEHL, FRED E.
The Texas Co.
135 East 42nd Street
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ROSNELL, JOHN E.
Texas Co.
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ROSS, EDGAR S.
Sun Oil Co.
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ROSS, F. R.
Alemite Co. of Pittsburgh
201 Shady Ave.
Pittsburgh, Pa.

ROSS, FRANK
E. F. Houghton & Co.
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Cleveland 3, Ohio

ROSSTEAD, OLIVER B. JR.
American Oil Co.
148 N. Fremont Ave.
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Pittsburgh 19, Pennsylvania

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480 Canal St.
New York 13, New York

ROUNDS, THOMAS E., JR.
The Barden Co.
E. Franklin St.
Danbury, Connecticut

ROWE, JAMES J.
Cities Service Oil Co.
70 Pine St.
New York, N. Y.

RUEDRICH, PAUL M.
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1000-16th Street
San Francisco 7, California

RUFFNER, ARTHUR F.
The J. W. Kelley Co.
3401 West 140th St.
Cleveland 11, Ohio

RUMBERGER, WILLIAM M.
Titan Metal Mfg. Co.
Bellefonte, Pa.

RUPP, JOHN C.
Colonial Beacon Oil Co.
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Brooklyn 22, N. Y.

RUTMAN, GEORGE J.
Sta-Vis Oil Co.
184 Eagle Street
St. Paul, Minnesota

RYAN, TRUXTON B.
Dingle-Clark Co.
1617 Pennsylvania Blvd.
Philadelphia 3, Pennsylvania

RYAN, VICTOR A.
Crown Cork & Seal Co., Inc.
Eastern Ave. & Kresson St.
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SAILER, ROMAN L.
Valvoline Oil Co.
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Franklin, Pennsylvania

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Air Material Command, AAF
Materials Lab., Beam 2
Wright Field, Ohio

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Hanna Building
Cleveland 15, Ohio

SATTER, CYRIL D.
United Eng. & Fry. Co.
1st National Bank Bldg.
Pittsburgh 22, Pennsylvania

SAUERBRUN, WILLARD E.
Sinclair Ref. Co.
10 West 51st St.
New York 20, New York

SAWYER, DAVID W.
Aluminum Research Labs.
P. O. Box 772
New Kensington, Pennsylvania

SCEATS, H. B.
McColl-Frontenac Oil Co.
1355 Burlington St., E.
Hamilton, Ont., Canada

SCHAAB, MILAN H.
Buffalo Bearings, Inc.
25 Terrace
Buffalo 2, New York

SCHAEFFER, CHARLES M.
Bethlehem Steel Co.
East 3rd Street
Bethlehem, Pennsylvania

SCHAFER, H. W.
D. A. Stuart Oil Co.
2727 S. Troy Ave.
Chicago, Illinois

SCHEIDELL, JOHN
Sun Oil Co.
1608 Walnut St.
Philadelphia 3, Pennsylvania

SCHENCK, Rand G., Sr.
Fiske Brothers Refining Co.
614 Ridgefield Avenue
Pittsburgh 16, Pennsylvania

SCHENKE, KURTISS P.
Application Co.
205 East 42nd St.
New York 17, New York

SCHLEICHER, ROWELL A.
Black Bear Company, Inc.
44-45 23rd Street
Long Island City 1, New York

SCHMITT, C. R.
E. F. Houghton and Co.
4500 Euclid Avenue
Cleveland 3, Ohio

SCHMITT, J. R.
Standard Oil Co. of Cal.
605 W. Olympic Blvd.
Los Angeles 54, California

SCHMITZ, CARL E.
Crane Packing Co.
1800 Cuyler Ave.
Chicago 13, Illinois

SCHMOOK, ROBERT
Sinclair Refining Co.
4161 P. Washington Rd.
Milwaukee 12, Wisconsin

SCHNEIDER, E. A.
Socony Vacuum Oil Co., Inc.
907 S. First Ave.
Milwaukee, Wisconsin

SCHOTT, JOHN E.
Socony Vacuum Oil Co., Inc.
412 Greenpoint Ave.
Brooklyn 22, New York

SCHROEDER, ELMER R.
Alemite Co. of Wis., Inc.
1010 N. Van Buren Street
Milwaukee 2, Wisconsin

SCHULTZ, R. E.
Socony Vacuum Oil Co.
907 South First Street
Milwaukee, Wisconsin

SCHWABE, HERMAN
Nathan Mfg. Co.
416 East 106th St.
New York 29, New York

SCOBIE, JAMES A., JR.
American Oil Co.
34 Greys Ferry Ave.
Philadelphia, Pennsylvania

SCOTT, CHARLES RALLYA
Wolf's Head Oil Ref. Co.
Fair Building
Oil City, Pennsylvania

SCOTT, FRANK J.
Crane Company
836 S. Michigan Ave.
Chicago 5, Illinois

SCOTT, GEORGE E.
Lincoln Engineering Co.
5701 Natural Bridge
St. Louis, Missouri

SCOTT, JAMES J.
Bound Brook Oil-less Bear. Co.
Bound Brook, New Jersey

SEIDL, HENRY C.
Wright Field
Dayton, Ohio

SELLEI, DR. HELEN
Standard Oil Co. of Ind.
Standard Oil Labs.
Whiting, Indiana

SELLERS, H. L.
Shell Oil Co., Inc.
700 N. Euclid Ave.
Dayton 7, Ohio

SEMLER, GEORGE W.
Standard Oil Co. of Pa.
35th and A. V. R. R.
Pittsburgh, Pennsylvania

SENIFF, RUSSELL W.
Gulf, Mob. & Ohio R. R. Co.
Bloomington, Illinois

SERVICE, MURRAY G.
Waverly Oil Works Co.
54th St.
Pittsburgh 1, Pa.

SETTLE, S. W.
Sun Oil Co.
3200 Independence Road
Cleveland, Ohio

SETZER, AUBREY
Colgate Palmolive Peet Co.
105 Hudson St.
Jersey City 2, New Jersey

SHAFFER, T. F.
Shell Oil Co., Inc.
2012 West 25th St.
Cleveland, Ohio

SHANKS, CARL
Panther Oil & Grease Mfg. Co.
840 N. Main St.
Fort Worth 1, Texas

SHANNON, JAMES G., JR.
The Texas Co.
6707 Dix
Detroit 11, Michigan

SHARPE, ROBERT Q.
Socony Vacuum Oil Co.
26 Broadway
New York, N. Y.

SHERMAN, THOMAS L.
Steel Products Engineering
1205 W. Columbia Street
Springfield, Ohio

SHUGART, J. W., JR.
Southwestern Petr. Co., Inc.
917 N. Main St.
Fort Worth, Texas

SCHULTZ, CLAUDE L.
Van Straaten Chemical Company
337 W Madison St.
Chicago 6, Illinois

SICKELER, OLEN D.
Spang Chalfant Co.
Duss Avenue
Ambridge, Pennsylvania

SIEBER, WILLIAM T.
Waverly Oil Works Co.
54th St. and A. V. R. R.
Pittsburgh, Pennsylvania

SIEFERS, H. KENNETH
United Oil Company
1800 N. Franklin Street
Pittsburgh 12, Pennsylvania

SIMMINGER, K. EDWARD
Bowser, Inc.
521 Arch St.
Philadelphia, Pa.

SIMON, JOHN
713 Wiley Avenue
McKeesport, Pennsylvania

SIPCHEN, JOHN H.
J. H. Sipchen and Co...
549 West Washington Boulevard
Chicago 6, Illinois

SIROTKIN, GEORGE V. B.
Kearney & Trecker Corp.
6784 W. National
West Allis, Wis.

SIZER, JOHN A., JR.
Ehret & Kinsey
327 S. LaSalle St.
Chicago, Illinois

SKELLY, JAMES J.
Circo Products Co.
12117 Berea Rd.
Cleveland 11, Ohio

SKYRUS, JOSEPH P.
Van Straaten Chemical Company
337 W. Madison St.
Chicago 3, Illinois

SLAVIN, ERNEST F.
Amoskeag Mach. Co.
Manchester, New Hampshire

SLOMER, JOS. J.
Goodman Mfg. Co.
49th and Halsted St.
Chicago 9, Illinois

SMALLEY, B. L.
L. R. Kerns Co.
2657 East 95th St.
Chicago, Illinois

SMITH, B. H.
Texas Div. Dow Chem. Co.
Freeport, Texas

SMITH, GEORGE L.
C. H. Clark Oil Co.
2625 East 76th St.
Cleveland 4, Ohio

SMITH, HAMILTON W.
Golden Bear Oil Co.
325 W. Eighth St.
Los Angeles 14, California

SMITH, JULIUS C.
Standard Oil Co. of California
225 Bush Street
San Francisco, California

SMITH, LAWRENCE H.
Gulf Oil Corp.
3800 Gulf Bldg.
Pittsburgh, Pa.

SMITH, MELVIN I.
Socony Vacuum Oil Co.
412 Greenpoint Ave.
Brooklyn 22, New York

SMITH, PARKER B.
Socony Vacuum Oil Co.
59 East Van Buren Street
Chicago 5, Illinois

SMITH, ROBERT O
Alemite Company
15501 Woodrow Wilson Avenue
Detroit, Michigan

SMITH, VICTOR W.
G. W. Smith & Sons, Inc.
5400 Kemp Road
Dayton 3, Ohio

SMITH, WILLIAM H.
Fiske Brothers Refining Co.
P. B. 1526 Central Station
Toledo, Ohio

SNYDER, CHARLES H.
National Ref. Co.
125 Elinor Ave.
Akron 9, Ohio

SOLLITT, C. ALEX
Campbell Lubricating Specialties
414 Eastern Avenue
Toronto, Ontario

SOMERVELL, S. Bruce
Application Co.
205 E. 42nd St.
New York 17, New York

SPARKS, STANLEY E.
Viscosity Oil Co.
3820 W. Pershing Rd.
Chicago, Illinois

SPICE, B. G.
Alox Corporation
510 N. Dearborn Street
Chicago 10, Illinois

STACK, JOHN W.
Standard Oil Co. (Ind.)
910 South Michigan Avenue
Chicago 80, Illinois

STAMM, JOHN C.
Standard Oil Co. of Ind.
Box 710
Whiting, Indiana

STANICH, V. M.
General Petroleum Corp.
2525 East 37th Street
Vernon, California

STARK, WILLIAM WELDON, JR.
Caltex (India) Limited
Caltex House
Bombay, India

STARKMAN, ERNEST S.
Shell Development Co.
4560 Horton St.
Emeryville, California

STECKEL, WILLIAM E.
International Chemical Co.
302 Tecumseh Road
Syracuse 10, New York

STEELE, ARLO L.
Robbins & Myers, Inc.
1345 Lagonda
Springfield, Ohio

STEELE, FINLEY M.
The Hilliard Corp.
102 W. 4th Street
Elmira, New York

STEPHAN, JOHN
American Can Co.
320 Elizabeth Ave.
Newark 8, New Jersey

STEVENSON, WM. E., JR.
Stevenson Oil & Chem. Co.
986 East 200
Cleveland 19, Ohio

STAINES, P. RAYMOND
The Davison Chem. Corp.
Curtis Bay Plant
Baltimore 3, Maryland

STILWELL, WILLIAM MOORE, JR.
Dingle-Clark Co.
1617 Pennsylvania Blvd.
Philadelphia 3, Pennsylvania

STINE, JAMES E.
Sun Oil Company
420 Lexington Avenue
New York 17, New York

STINSON, PHILIP M.
Philip M. Stinson
2621 Virginia Park
Detroit 6, Michigan

STOCKWELL, FRED E.
Colonial Beacon Oil Co.
378 Stuart St.
Boston 17, Massachusetts

STOEHR, ALFRED F.
Cities Service Oil Co.
1320 Macklind
St. Louis 10, Missouri

STOKELY, JOHN M.
California Res. Corp.
576 Standard Ave.
Richmond, California

STONER, WILLIAM
Lukens Steel Co.
Coatesville, Pennsylvania

STRANAHAN, L. H.
White Motor Co.
842 East 79th Street
Cleveland 1, Ohio

STRINGER, H. G.
Shell Oil Co.
154 Bagley
Detroit, Mich.

STROHECKER, ROBERT F.
The Texas Co.
Beacon, N. Y.

STROHMAIER, ALFRED J:
E. I. duPont deNemours & Co.
1700 Market Street
Wilmington 98, Delaware

STUART, CARL B.
Shell Oil Company
49 Worthington Avenue
Youngstown, Ohio

STURGIS, DR. BERNARD M.
E. I. du Pont de Nemours & Co.
Jackson Laboratory
Wilmington, Delaware

STUTSON, A. C.
Socony-Vacuum Oil Co., Inc.
26 Broadway
New York, N. Y.

SUHRE, A. B.
National Refining Co.
1600 Clark Avenue
St. Louis, Missouri

SUMNER, GEORGE L.
Westinghouse Electric Corp.
East Pittsburgh, Pennsylvania

SUMNER, GEORGE LEWIS, JR.
Gulf Research and Development Co.
P. O. Box 2038
Pittsburgh 30, Pennsylvania

SUNDHEIMER, WALTER
Shell Oil Co., Inc.
5831 York Rd.
Baltimore 12, Maryland

SVENSON, E. B.
Aluminum Company of America
New Kensington, Pennsylvania

SWEATT, CHARLES H.
Linde Air Products Co.
E. Park Drive and Woodward
Tonawanda, New York

SWIFT, CLINTON E.
908 North Stoneman
Alhambra, Cal.

SWYGARD, A. C.
Aro Equipment Corp.
Bryan, Ohio

SYMON, B. G.
Shell Oil Co., Inc.
50 West 50th Street
New York 20, New York

TACHOIR, LEO
Tide Water Assoc. Oil Co.
1510 Arrott Bldg.
Pittsburgh 22, Pennsylvania

TALLEY, S. K.
Shell Development Co.
4560 Horton Street
Emeryville 8, California

TAYLOR, ARTHUR J.
Johns Manville Corp.
Manville, New Jersey

TAYLOR, J. I. C.
Sun Oil Co.
Grant Bldg.
Pittsburgh 19, Pennsylvania

TAYLOR, O. J.
Gulf Oil Corp.
Cross St. & P. R. R.
Pittsburgh, Pennsylvania

TAYLOR, WILLIAM C.
Sun Oil Co.
1608 Walnut St.
Philadelphia 3, Penn.

TEAGUE, WALTER E.
Richfield Oil Corp.
1835 E. Washington
Los Angeles 21, California

TEAL, PERCY P
Alemite Co. of Eastern Penna.
704 North 16th St.
Philadelphia, Pennsylvania

TERRELL, HOWELL H.
Sinclair Ref. Co.
633 N. Front St.
Memphis, Tennessee

THARP, LEWIS R.
E. F. Houghton & Co.
P. O. Box 1806, Cabanne Station
St. Louis 12, Mo.

THAYER, C. D.
Socony-Vacuum Oil Co.
412 Greenpoint Ave.
Brooklyn 22, New York

THOMAS, O. J.
Lincoln Engineering Co.
1439 S. W. 6th Ave.
Portland 1, Oregon

THORKELSON, R. H.
Dingle-Clark Co.
1248 Engineers Building
Cleveland 14, Ohio

THORPE, ROY E.
Shell Development Co.
53rd and Horton
Emeryville 8, California

THUREN, ARTHUR I.
Swan-Finch Oil Corp.
201 N. Wells St.
Chicago 6, Illinois

TICHVINSKY, LEONID M.
Washington University
St. Louis 5, Missouri

TIERNAN, JAMES B.
Lubriptate Div. of Fiske Bros. Ref. Co.
129 Lockwood St.
Newark 5, New Jersey

TISDALL, TREVOR H.
Colonial Beacon Oil Co.
50 Rockefeller Plaza
New York, New York.

TODD, HOWARD P.
American Oil Co.
R. D. No. 5
Butler 1, Pennsylvania

TOUPENCE, LOUIS J.
Chek-Chart Corp.
624 S. Michigan Ave.
Chicago 5, Illinois

TOWNSEND, F. LEE
Wm. W. Nugent & Co.
410 Hermitage Ave.
Chicago 22, Ill.

TOWNSEND, F. LEN
E. F. Houghton & Co.
3516 S. Shields Ave.
Chicago 9, Illinois

TREFFEISEN, G.
Alemite Div. of Stewart-Warner Corp.
1826 W. Diversey Parkway
Chicago 14, Illinois

TREXLER, JAY
Shell Oil Company, Inc.
909 East 22nd Street
Baltimore 18, Maryland

TURNAU, EDMUND H.
Shell Oil Co., Inc.
1066 Madison Avenue
Albany 3, New York

TURNER, A. H.
Standard Oil Co.
1801 East First St.
Dayton, Ohio

TURNLEY, M. W.
Wayne Chemical
9600 Copland
Detroit 17, Michigan

TURPIN, PAUL L.
Lincoln Engineering Co.
2415 S. Michigan Ave.
Chicago 16, Illinois

TWISS, HARRY O.
Sinclair Ref. Co.
1741 Waterman Ave.
Detroit 9, Mich.

UHL, P. W.
Detroit Diesel Engine Div.
13400 W. Outer Drive
Detroit 23, Michigan

ULBRICH, RICHARD W.
Swan-Finch Oil Corp.
RCA Bldg. West
New York 20, New York

UNKS, L. T.
Sun Oil Co.
3200 Independence Street
Cleveland, Ohio

URIBE, W.
Tropical Oil Company
Apartado 335
Bogota, Colombia, S. A.

URSEM, WILLIAM A.
F & W Ursem Company
1548 West 117th Street
Cleveland 7, Ohio

VAN DER BURCH, DIRK
Shell Oil Co., Inc.
1663 East 79th St.
Chicago, Illinois

VAN EYCK, PHILLIP B.
Essex Brass Corp.
2000 Franklin
Detroit 7, Michigan

VANGUNDY, JOHN C.
Texas Company
135 East 42nd Street
New York 17, New York

VAN HEECKEREN, W. J.
Philips Labs., Inc.
145 Palisade St.
Dobbs Ferry, New York

VICKERS, ALBERT
Dominion Fdys. & Steel, Ltd.
Depew St.
Hamilton., Ont., Canada

VOELKER, JOHN W.
DeLaval Sales & Service
447—4th Ave.
Pittsburgh 19, Pennsylvania

VOGELY, EMIL H., JR.
Cincinnati Milling Mach. Co.
3701 N. Broad St.
Philadelphia, Pennsylvania

VOLLINK, HAROLD J.
National Ref. Co.
101 Smith St.
Flint, Michigan

VON FUCHS, GEORGE H.
Shell Oil Company, Inc.
Wood River, Illinois

VOSHELL, B. C.
Socony-Vacuum Oil Co., Inc.
26 Broadway
New York 4, New York

WACHOWICZ, JOHN S.
Carnegie-Illinois Steel Corp.
3426 East 89th Street
Chicago, Illinois

WADDELL, J. N.
Henry H. Cross Co.
122 South Michigan Avenue
Chicago 3, Illinois

WAGNER, EARL E.
Hoover Ball & Bearing Co.
326 E. Hoover Ave.
Ann Arbor, Michigan

WALKER, GEORGE MARK
Shell Oil Company, Inc.
12 Providencia
Burbank, California

WALKER, HAROLD J.
Sinclair Refining Company
Box 186
Indianapolis, Indiana

WALSTRA, JESSE C.
L. R. Kerns Co.
2657 East 95th Street
Chicago 17, Illinois

WARD, DAMIEN J.
Alemite Sales Co.
59 East 25th St.
Chicago 16, Illinois

WARNECKE, CHARLES L.
Armstrong Cork Co.
Lancaster, Pa.

WARNER, JOHN T.
Carnegie—Ill. Steel Corp.
Gary Sheet and Tin Mill
Gary, Indiana

WARNER, WILLIAM P.
The Texas Co.
Lee & Aycock Sts.
Greensboro, North Carolina

WATERS, MARSHALL J.
Shell Oil Co., Inc.
100 Bush St.
San Francisco, California

WEBSTER, PAUL T., JR.
Central Petroleum Co.
548 Standard Bldg.
Cleveland 13, Ohio

WEBSTER, WILLIAM W.
Harrison Radiator Corp.
West Plant
Lockport, New York

WEGMAN, THEO. H.
A. O. Smith Corp.
3533 North 27th St.
Milwaukee 1, Wisconsin

WEIGHTMAN, ALBERT EDWARD
Tidewater Oil Co. of Canada, Ltd.
201 Weston Road, South
Toronto, Canada

WEINKAUF, C. E.
The Hodson Corp.
916 Union Trust Bldg.
Pittsburgh, Pennsylvania

WEIS, GEO. F.
A. O. Smith Corp.
3533 North 27th St.
Milwaukee, Wisconsin

WEISMANN, GEORGE F.
General Petroleum Corp.
1038 West 2nd St.
Los Angeles 12, California

WEISS, VICTOR A.
Allis-Chalmers Mfg. Co.
1126 South 70th St.
West Allis 14, Wisconsin

WELCH, L. C.
Sandard Oil Co. (Ind.)
910 South Michigan Avenue
Chicago 80, Illinois

WELDON, TED H.
Alemite Co. of Nashville, Tenn.
122—15th Ave., South
Nashville, Tennessee

WENDT, PAUL W.
Grafo Colloids Corp.
431 South Dearborn St.
Chicago 5, Illinois

WENDT, PAUL W., JR.
Grafo Colloids Corp.
431 S. Dearborn St.
Chicago 5, Illinois

WENDT, W. MAYNARD
Grafo Colloids Corp.
431 S. Dearborn St.
Chicago 5, Illinois

WENTWORTH, IRA R.
Sinclair Refining
2540 W. Cermak Rd.
Chicago 8, Illinois

WESTBO, Warren P.
Faber Labs.
51-57 Franklin St.
New York 13, New York

WERNER, ROBERT CLAUDE
Humble Oil & Refining Co.
402 Republic Bldg.
Houston 2, Texas

WHITE, LYSANDER THOMAS
Petroleum Advisers, Inc.
70 Pine
New York 5, New York

WHITE, ROBERT B.
Alemite Co. of So. Calif.
333 W. Washington
Los Angeles 15, California

WHITE, ROBERT C.
Detrex Corporation
13005 Hillview
Detroit 27, Michigan

WHITE, TED
Ralph P. Keelor Co.
1417 Lake St.
Cleveland, Ohio

WHITE, W. HARRY
The Atlantic Refining Co.
1100 Chamber of Commerce Bldg.
Pittsburgh 19, Pennsylvania

WHITEHEAD, DONALD E.
Carnegie Illinois Steel Corp.
Carnegie Building
Pittsburgh, Pennsylvania

WHITELEY, N. I.
American Steel & Wire Co.
Rockefeller Bldg.
Cleveland, Ohio

WHITTLETON, THEODORE
Alox Corporation
Buffalo Avenue
Niagara Falls, New York

WILEY, NORMAN DOUGLAS
Shell Oil Company, Inc.
11240 Pico Blvd., West
Los Angeles, California

WILKE, ADOLPH PETER
Omar Bakery, Inc.
2130 W. Clybourn Street
Milwaukee 3, Wisconsin

WILKINSON, RALPH E.
Aro Equipment Corp.
231 West Wisconsin Avenue
Milwaukee 3, Wisconsin

WILLEY, ARTHUR O.
The Lubri-Zol Corp.
Box 3057 Euclid Station
Cleveland 17, Ohio

WILLIAMS, DUNCAN B.
Carbide & Carbon Chem. Corp.
30 East 42nd St.
New York 17, New York

WILLIAMS, GEO. T.
Mine & Smelter Supply Co.
1422—17th
Denver 2, Colorado

WILLIAMS, WESLEY B.
Wayne Chemical Prod.
9602 Copeland
Detroit 17, Michigan

WILLIAMSON, GEORGE
Penola, Inc.
Pt. of Deacon St.
Detroit, Mich.

WILLIS, W.
Willis Lubricating Co.
P. O. Box No. 181
Steubenville, Ohio

WILLSON, EDWARD A.
Grafo Colloids Corp.
310 Wilkes Place
Sharon, Pennsylvania

WILSON, DONALD H.
Continental Steel Corp.
South Plant
Kokomo, Indiana

WILSON, LESLIE E.
Carnegie, Ill., Steel Corp.
3426 East 89th St.
Chicago, Illinois

WING, PAUL R.
Shell Oil Co., Inc.
611 Las Juntas St.
Martinez, California

WINN, CHARLES M.
Carnegie, Ill., Steel
Salt Springs Rd.
Youngstown, Ohio

WINTER, PAUL M.
Cities Service Oil Co.
Railroad and Walnut Sts.
Kingston, Pa.

WINTER, WILLIAM R.
Standard Oil Co. (Ind.)
414 W. Michigan St.
Milwaukee 3, Wisconsin

WIRTH, CHARLES III
E. I. du Pont de Nemours & Co.
1811 S. Baltimore Ave.
Tulsa, Oklahoma

WIRTH, FLOYD J.
Cities Service Oil Co.
6611 Euclid Avenue
Cleveland, Ohio

WISE, MILTON A.
General Petr. Corp.
108 West 2nd St.
Los Angeles 12, California

WITHROW, RAYMOND C.
Freedom Valvoline Oil Co.
1008 Peoples Bank Building
Pittsburgh, Pennsylvania

WITT, C. O.
Shell Oil Co.
100 Bush St.
San Francisco 6, California

WOLMER, CHARLES E.
American Cyanamid Co.
1937 West Main St.
Stamford, Conn.

WOOD, H. STUART
American Cyanamid Co.
30 Rockefeller Plaza
New York 20, N. Y.

WOODLAND, ALVIE
Lincoln Engineering Co.
5781 Natural Bridge
St. Louis 20, Mo.

WORLEY, ROBERT B.
Warren Refining and Chemical Co.
308 Euclid Avenue
Cleveland 14, Ohio

WORTHINGTON, HOWARD L.
Remington Arms Co.
939 Barnum Ave.
Bridgeport, Connecticut

WRIGHT, W. ANDREW
Sun Oil Company
Marcus Hook, Pa.

WRIGHT, GEORGE T.
Dominion Fdys. & Stee.
Depew St.
Hamilton, Ont., Canada

WRIGHT, WARREN O.
Bijur Lubricating Corp.
43-01 22nd Street
Long Island City 1, New York

WRIGHT, W. A. S.
Union Oil Co.
617 W. 7th Street
Los Angeles 14, California

WRIGHT, WILLIAM J.
Gulf Refining Co.
Maison Blanche Building
New Orleans 16, Louisiana

WUERZ, OSCAR W.
Parmelee Motor Fuel Co., Inc.
315 West 68th St.
New York 23, New York

YERKES, JOSEPH H.
Jos. H. Yerkes & Co.
3715-17 Washington Ave.
St. Louis 8, Missouri

YOUNG, TROY RICHARD
Box 113
Rochester, New York

YOUNGCLAUS, WILLIAM P., JR.
Stewart-Warner Corp.
1826 W. Diversey Parkway
Chicago, Illinois

ZATWARSKY, CHESTER J.
Warner & Swasey
5701 Carnegie
Cleveland 3, Ohio

ZINO, ANTHONY JOSEPH, JR.
Swan-Finch Oil Corp.
RCA Building, West
New York 20, New York

ZURAWSKY, FRANK, JR.
Grafo Colloids Corp.
310 Wilkes Place
Sharon, Pa.

INDUSTRIAL MEMBERSHIP*

ALUMINUM CO. OF AMERICA
New Kensington, Pennsylvania
Dr. E. M. Kipp

AMERICAN STEEL FOUNDRIES
410 North Michigan Avenue
Chicago 1, Illinois
Mr. R. D. Brizzolara

CARNEGIE-ILLINOIS STEEL CORP.
Carnegie Building
Pittsburgh 30, Pennsylvania
No representative appointed

CRANE COMPANY
836 South Michigan Avenue
Chicago 5, Illinois
Mr. F. J. Scott

DOW CHEMICAL CO.
Midland, Michigan
Mr. E. F. Graves

FARVAL CORP.
3249 E. 80th Street
Cleveland 4, Ohio
Mr. A. J. Jennings

GITS BROTHERS MANUFACTURING CO.
1846 S. Kilbourn Avenue
Chicago 23, Illinois
Mr. Frank Kovarik

HODSON CORP.
5301-11 West 66th Street
Chicago 38, Illinois
Mr. W. H. Hodson

HONAN-CRANE CORPORATION
409 Indianapolis Avenue
Lebanon, Indiana
Mr. F. G. Fisher

E. F. HOUGHTON AND COMPANY
303 West Lehigh Avenue
Philadelphia 33, Pennsylvania
Mr. Frank Ross

INLAND STEEL CO.
38 South Dearborn Street
Chicago 3, Illinois
Mr. D. N. Evans
Mr. B. C. Voshell

L. R. KERNS CO.
2657 E. 95th Street
Chicago, Illinois
Mr. L. R. Kerns

LINCOLN ENGINEERING CO.
5701 Natural Bridge Avenue
St. Louis, Missouri
Mr. A. P. Fox

LUBRI-ZOL CORP.
Box 3057 Euclid Station
Cleveland 17, Ohio
Mr. Arthur O. Willey

NOX-RUST CHEMICAL CORPORATION
2429 S. Halsted Street
Chicago 8, Illinois
No representative appointed

PRECISION SCIENTIFIC COMPANY
3737 W. Courtland Street
Chicago, Illinois
Mr. J. P. Duray

PYLE NATIONAL COMPANY
1334 N. Kostner Avenue
Chicago, Illinois
Mr. R. J. Jesse

REPUBLIC STEEL CORP.
Republic Building
Cleveland, Ohio
Mr. C. E. Pritchard

SHELL OIL CO., INC.
50 W. 50th St.
New York, New York
Mr. B. G. Symon

SINCLAIR REFINING COMPANY
630—Fifth Avenue
New York 20, New York
Mr. C. M. Larson

J. H. SIPCHEN COMPANY
549 West Washington Street
Chicago 6, Illinois
Mr. J. H. Sipchen

SOCONY-VACUUM OIL CO., INC.
26 Broadway
New York 4, New York

STANDARD OIL CO. OF CALIFORNIA
Standard Oil Building
San Francisco 20, California
Mr. J. C. Smith

STANDARD OIL OF INDIANA
910 South Michigan Avenue
Chicago 80, Illinois
Mr. L. C. Welch

STEWART-WARNER CORP.
1826 Diversey Parkway
Chicago, Illinois
Mr. G. Treffeisen

SUN OIL CO.
1608 Walnut Street
Philadelphia 3, Pennsylvania
Dr. E. S. Ross

SWAN-FINCH OIL CORP.
201 N. Wells St.
Chicago 6, Illinois
Mr. Sam W. Bodman

TEXAS COMPANY
135 East 42nd Street
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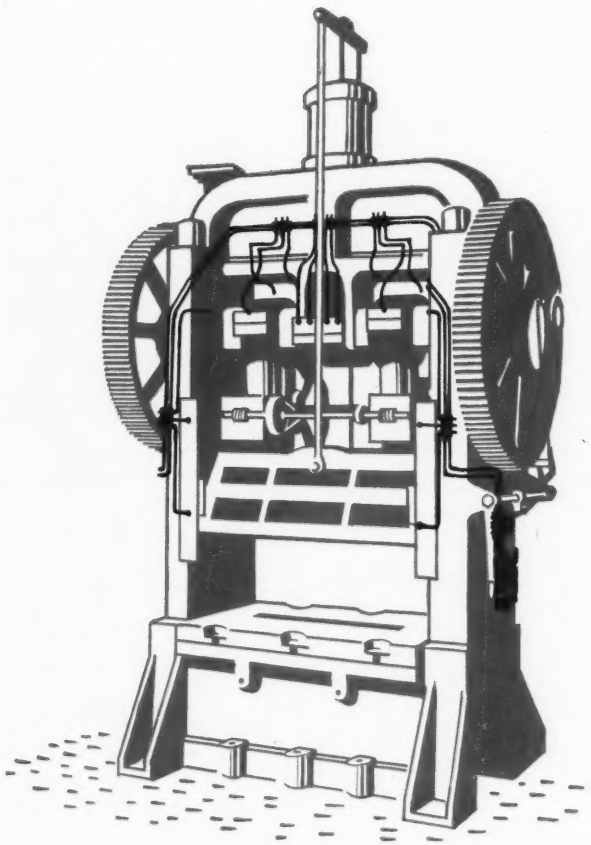

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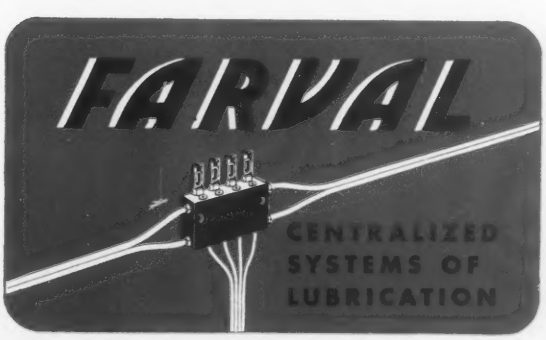

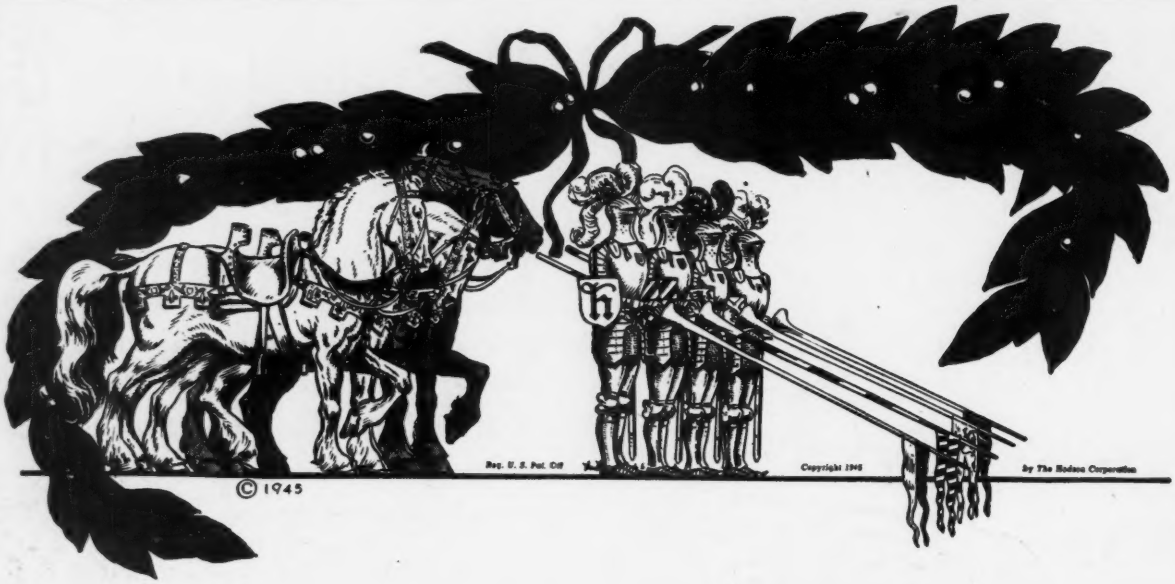

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